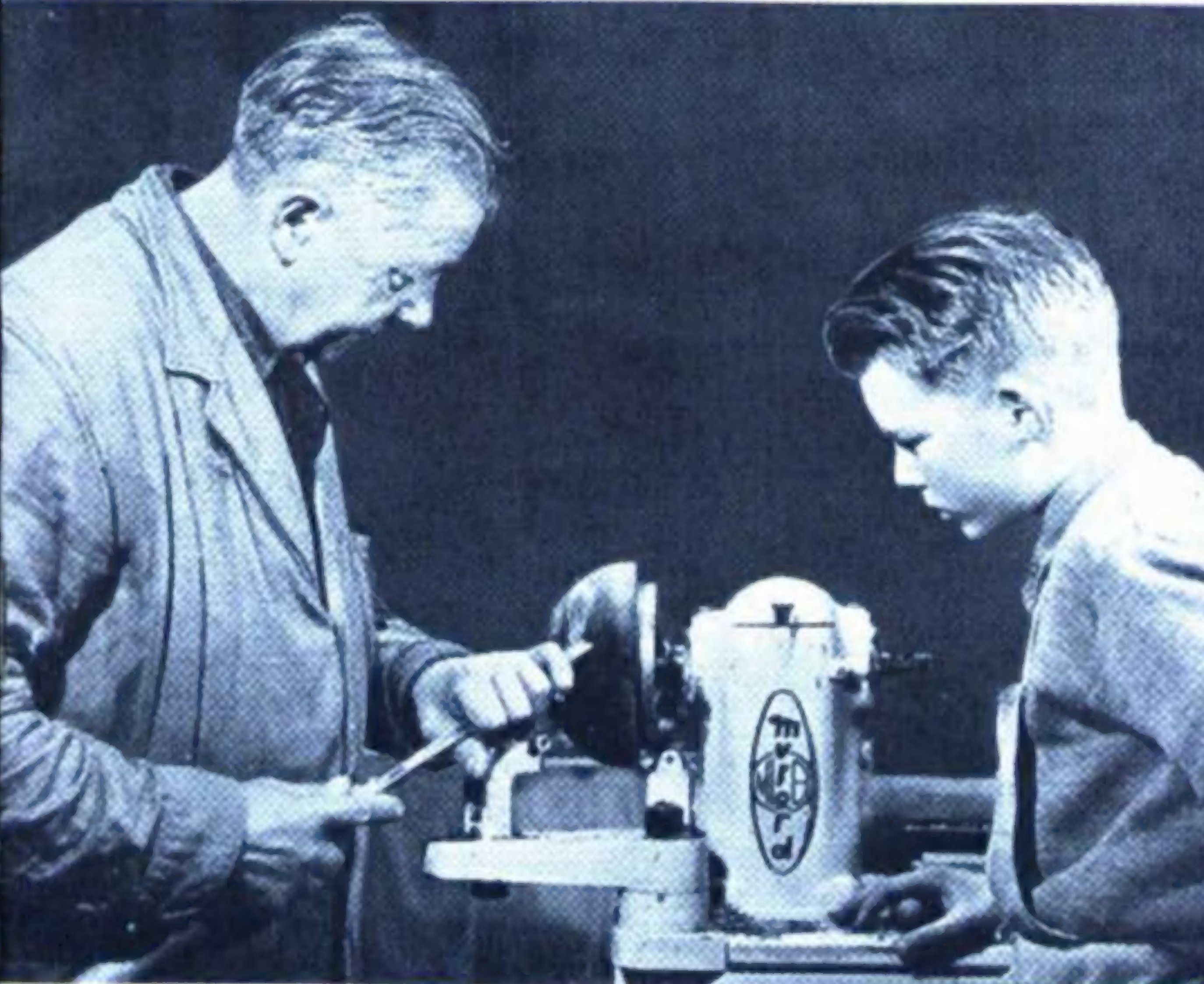
THE MODEL ENGINEER



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THE MODEL ENGINEER

EVERY THURSDAY

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Our Cover Picture

The craft of woodturning is one of the oldest in industry, but has been brought up to date by the introduction of modern machines and methods. It offers great scope for individual skill and artistic taste, and never fails to fascinate both the operator and the spectator. While not essentially a branch of mechanical engineering, it serves a very useful purpose in connection with pattern making and similar allied industries. In addition, it is a very good medium for training in manual craftsmanship as it helps the worker to acquire the "feel" of cutting tools, the effect of tool angles on cutting efficiency, etc. One of the best known exponents of this craft is Mr. F. Pain, of High Wycombe, whose demonstrations at several successive "M.E." Exhibitions have always been a centre of interest, and at last year's Exhibition, he was ably assisted by Master Derek Martin, who at 14 years of age has already acquired a very commendable degree of skill in the use of the woodturning lathe. Mr. Pain is seen here turning an elm fruit bowl on the "outboard" mandrel extension of his Myford M.L.8 lathe, and his methods are closely followed by his assistant.

SMOKE RINGS

Straight to the Point

WE HAVE received a letter from Mr. C. E. Hooker, of Ditton, Kent, who has had fifty years of experience with traction engines, steam cars and wagons, and has been a subscriber to THE MODEL ENGINEER since 1900. He has some pertinent remarks to make about certain model traction engines; he writes: "I feel that if a person is copying a prototype and calls his model by a known name, it should fairly represent the original and not as I saw one at the 'M.E.' Exhibition, a $\frac{3}{4}$-in. scale engine called a Burrell, but looked like nothing on earth." We fully agree with this idea and also with Mr. Hooker's opinion that anyone building a model according to his own ideas is entitled to describe it as a traction engine if the model resembles a traction engine. Mr. Hooker says he is often irritated by seeing model traction engines in which the crankshaft is much too high; the flywheel should be well down behind the driving wheel.

Mr. Hooker adds: "With all due respect to W. J. Hughes, double high-pressure engines *were* made, and if I needed an engine, that is what I should have today. I am building a 2-in. scale model to this design. Also, traction engines did not hammer or pound their way along the roads; the crossbars (strakes) were stretched by the rolling action, the effect being the same as in a steel-rolling mill, though naturally much slower, taking months instead of seconds."

Steam Holding its Own

REFERRING TO our comments under the heading "On the Grand Scale" in the "M.E." for December 18th last, some readers have suggested that our remark that steam "is holding its own" is an understatement, and that we would have been nearer the truth if we had stated that steam is coming back into its own. We are reminded that, in addition to the latest power stations, the Royal Navy's latest ships are steam driven, as are several new ships for the Merchant Navy.

Be this as it may, we are not so sure that steam, as a source of power, has ever lost its place, and we think he would be a bold man who asserted that it had. Other sources of power have naturally claimed more popular attention, in recent times, but we doubt if the convenience of steam plant, in certain circumstances, has ever been seriously challenged. Hence, our reference to its "holding its own" was deliberate.

High-pressure, highly superheated steam is a formidable and economical source of power that cannot be lightly cast aside, and seems destined to hold its own for so long as power is required. Methods of generation and utilisation will undoubtedly change as new ideas are applied, but we see no reason to suppose that some form of steam engine, or steam turbine, will ever be superseded.

The Andover Road Locomotive Rally

FURTHER TO our recent announcement of the forthcoming Road Locomotive Rally at Andover next Easter, we learn that the following owners hope to be there with their engines:

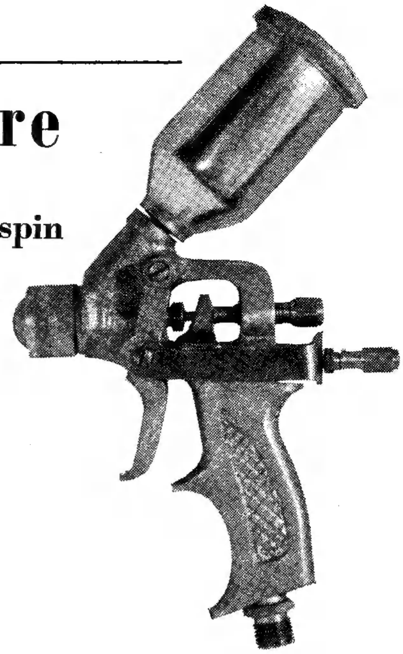
Mr. Napper, of Appleford, with a Burrell tractor; Mr. Corbett, of Itchen Abbas, with the Burrell "scenic" engine, *Prince of Wales*; Mr. Woollett, of Dursley, with a Foden tractor; Mr. Lucas, of Salisbury, with his Fowler, *The Lion*; Mr. Newbery, of Kingsclere, with his Marshall 6 n.p.h. three-speed agricultural engine, and Mr. Fisher, of Reading, with a one-third size traction engine. All these together should be worth seeing.

Change of Secretary

WE HAVE been asked to draw special attention to a further change of secretary of the Bristol Society of Model and Experimental Engineers. Due to leaving the district, Mr. H. W. Woodward has been obliged to relinquish office. He has been succeeded by Mr. W. E. Round, 14, Britannia Road, Kingswood, Bristol, to whom all communications should be sent in future.

A simple high-pressure spray gun

By B. Terry Aspin



THERE remains the fitting of the hinge-pins to carry the trigger but, to ensure the latter working smoothly as it should do, it is recommended that the trigger be finished first and brought to a nice fit over the bosses before attempting to locate the exact position of the pins. A couple of plated 4-B.A. screws were used in the original, but an alternative arrangement is shown in the sketch (Fig. 5). The screws are simple enough to make from brass rod but it is possible that some discarded piece of electrical equipment may provide the answer in the form of a nice, plated example of a male and female screw.

The Turned Parts

Before commencing to make the needle-valve and air-valve assemblies perhaps it would be as well to complete the jet and nozzle although, in fact, the order is immaterial, except that it would assist in estimating the exact length of the needle.

The jet is a simple turning from hexagon brass rod with a threaded portion, $\frac{5}{16}$ in. × 26 t.p.i. shouldered by a 45 degree cone to correspond with the seating prepared for it in the nose of the gun. If a really good fit is obtained no packing will be necessary, and thus the alignment will be less likely to be disturbed. If any leakage occurs here, air will blow back through the colour and make spraying impossible. The front of the jet is turned to a 60 degree taper and if, after turning this the top-slide is allowed to remain, an exactly corresponding taper can be cut inside the nozzle at the next operation. Before parting off, the jet is bored through with a No. 54 drill and opened out to allow plenty of clearance round the needle. The extremity of the conical tip should be turned to the same diameter ($\frac{1}{8}$ in.) as the drill to be used for boring the nozzle and, transferred to the drilling machine, the small indentation can be formed with the aid of a $\frac{1}{8}$ in. centre drill.

It will be seen that, in operation, the volume of air is regulated by the clearance between the $\frac{1}{8}$ in. hole in the nozzle and the waist behind the conical tip of the jet.

The nozzle is another simple turning job and it can be made from light alloy, brass or bronze stock as available. It is preferable that it be reasonably non-corrosive, so mild-steel is not recommended. In the original gun it is made from bronze stick cast at home. The 60 degree internal cone ensures that its alignment with the jet is maintained. Concentricity is important. A gun so constructed will spray and not splatter! Four radial ducts are afterwards filed inside the cone to carry the air. They need be cut only so deep that their combined capacity is obviously greater than that of the aperture between the jet and nozzle when the latter is in position. (Fig. 6.)

Final to the jet assembly is the screwed locking ring which holds the nozzle in position on the gun. As already recorded, a short length of dural tube was pressed into service for this part but it could have been included in the foundry programme.

The needle-valve assembly, gland, sleeve and adjustment-screw require brass rod again. Round if a knurling tool is available but hexagon answers very well. The gland is a simple screw threaded $\frac{5}{16}$ in. × 26 t.p.i. and bored $\frac{1}{8}$ in. If it is a close fit on the rod to be used for a needle it requires no packing. The adjusting-screw is threaded likewise and bored blind 13/64 in. and the brass sleeve or plunger is turned to a sliding fit within it with a collar left at the front end. Except for the tapped portion which screws on to the needle, the sleeve is itself bored blind to accommodate the return spring, which will have to be no more than $\frac{3}{16}$ in. o.d. and, at the same time, quite strong.

Probably the ideal material for the needle is stainless-steel, $\frac{1}{8}$ in. diameter. It should be turned (or if it is too tough, filed) to a blunt point and it will be an advantage if it is arranged to penetrate the jet completely, as this will result in self-cleaning. It should not, however, penetrate beyond the jet,

Concluded from page 97, January 22, 1953.

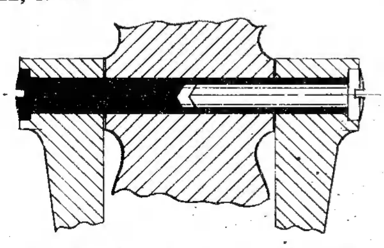


Fig. 5. Alternative trigger hinge-pin

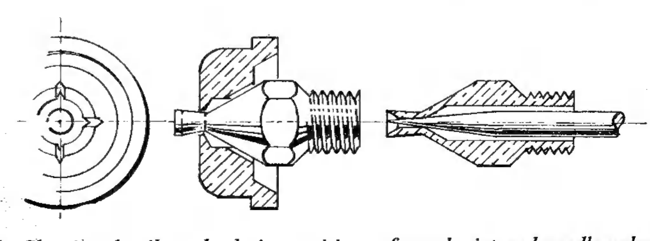


Fig. 6. Showing details and relative positions of nozzle, jet and needle-valve

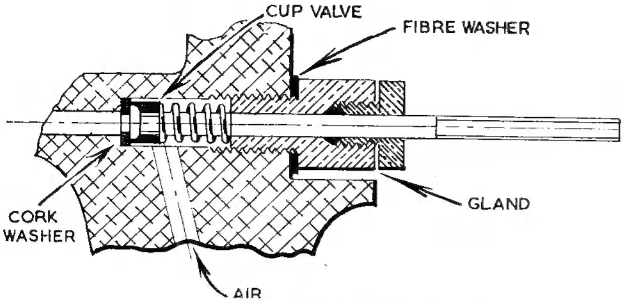


Fig. 7. Details of the air-valve

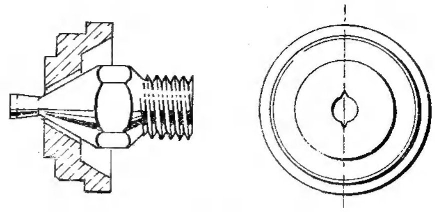


Fig. 8. The spreader

as it would be in danger of becoming bent. The butt-end of the needle is, of course, appropriately screwed to fit the brass sleeve. $\frac{1}{8}$ in. Whit. or 5 B.A. will do.

The arrangement of the air-valve is shown in the drawing and consists essentially of a knife-edged, cup-valve (an original description) seating on a cork washer. The latter is located on the shoulder provided for it by the $\frac{1}{4}$ in. counter-bore in the earlier stages. (Fig. 7.)

Theoretically, the pressure of air serves to assist the spring in maintaining the valve closed and a gland is provided to reduce leakage as far as possible. Adjustment is also provided so that the air-valve can be arranged to open slightly in advance of the colour valve and, incidentally, if leakage is to be tolerated at all it may be in the air, but never in the colour supply.

Here again, $\frac{1}{8}$-in. stainless-steel is used for the valve-rod but the remainder of the parts are turned from brass. It will be advisable to use hexagon for the gland to enable this to be tightened down satisfactorily and for this, and for the spot-facing at the base of the gun where the air-line adaptor is screwed in, fibre washers are employed.

The Stirrup

For conveying the movement of the trigger to the air and colour valves a stirrup is provided. The most suitable material for this is stainless-steel sheet of about 30 thou. thickness but, of course, sheet brass of similar gauge would do, while aluminium would probably prove too soft. This latter metal may, however, be used to some advantage to cut a sort of working template which can be tried out and adjusted to the gun. Fitted to satisfaction, it can be flattened out again and used as a guide for the cutting of the final product which, itself, need not be marred by experimenting. The shape can be sawn out easily with a piercing-saw.

Shouldered screws can be made for hinging the stirrup to the trigger, but screws and washers would be equally effective. If screws about 4 B.A., with nicely domed and plated heads can be found the appearance will be very satisfactory. The threaded holes to take them should not be drilled in the trigger until the exact position of the stirrup has been established.

An adaptor for the colour container must be made and this consists of a threaded sleeve, $\frac{5}{16}$ in. × 26 t.p.i. and one inch long, after which there remains only the cup itself, with its lid, to be completed. The cup can be turned all over and bored out to a thickness of about 40 thou. with safety and, while the outside will doubtless be expected to take a polish the inside also

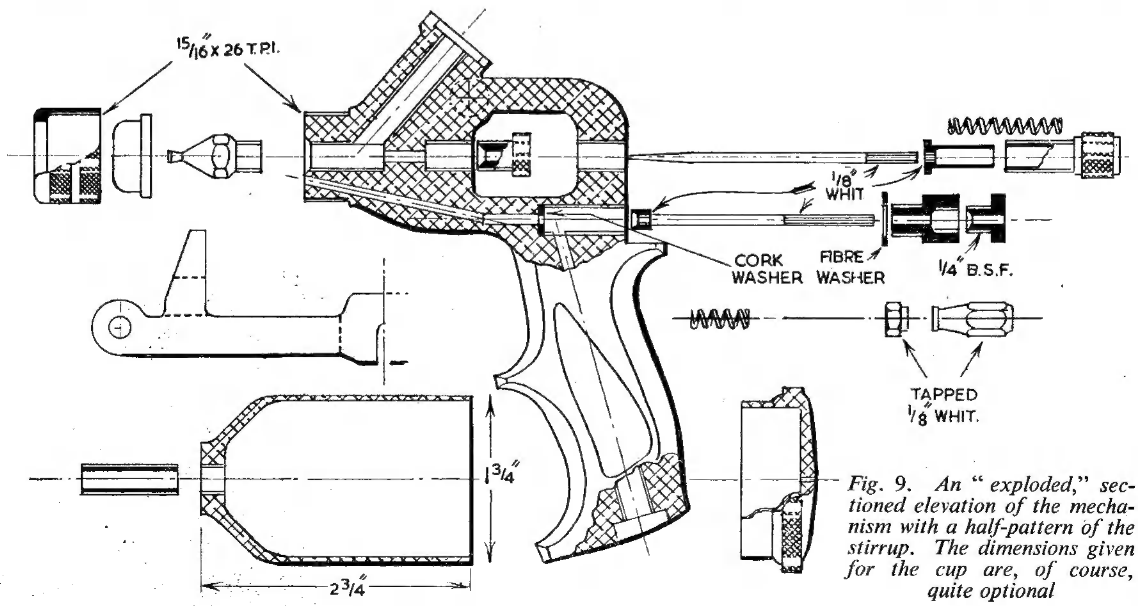


Fig. 9. An "exploded," sectioned elevation of the mechanism with a half-pattern of the stirrup. The dimensions given for the cup are, of course, quite optional

should be turned out smoothly and free from ridges to allow of easy cleaning. The lid can be hollowed out to remove surplus metal and the flange should be slightly tapered so that it will grip the inside of the container. A tiny vent hole is also required in the top.

An Alternative Nozzle

The nozzle already described will give a satisfactory spray for most requirements in the field of model painting but, if a larger area is to be covered, an alternative spreader to give a fan-shaped spray can be employed to some advantage.

In this case the internal cone continues right to the aperture and is without the recess as in the nozzle. The spreader projects no further than the waist on the fore-part of the jet and it should fit closely to the cone so that, without the ducts, there would be no passage for the air. These latter are two in number, situated diametrically opposite to one another and they can be opened out gradually with a file, testing alternately, until they deal with precisely the volume of air required. (Fig. 8.)

Operation

In the construction and adjustment of this gun there are a few main points to watch in order to ensure success.

(1) That there is no leakage of compressed air into the colour channels.

(2) That the colour-valve closes properly and does not open before the air-valve. Spitting is the result of these faults.

(3) That the nozzle, jet and needle are quite concentric with each other and that the latter is quite free to move due to pressure on the trigger and free to return under the influence of the spring.

(4) The air supply should be free from leaks and it is essential that it is adequate. The gun will work quite well down to as little as 20 lb. per sq. in. and consumes less than 2 cu. ft. per min. Quite naturally, of course, the volume consumed is proportional to the pressure as, likewise, is the spread of the fan or cone of colour.

Generally speaking the best results will be obtained if the pressure is maintained at between 30 and 40 lb. per sq. in. With cellulose it may be found that a much higher pressure will tend to dry the paint before it reaches its objective and the resultant finish will be quite matt. In fact, the writer has made use of this precise phenomenon where a matt finish has been especially required.

The effect of colour in the workshop

By P. W. Blandford

THERE is something about an attractive finish on the tools we use which encourages us to use them to produce good results. We approach a lathe with neat chromium-plated handles, coloured knobs and a sleek appearance with the feeling that this is going to produce a good job, yet another lathe just as accurately made in the vital parts, but without the attention given to finish, starts with a disadvantage. Colour can have the same effect.

A light, cheerful workshop with a correctly-chosen colour scheme makes for accurate and more efficient work, doing something to instil in the worker a feeling of mastery and a wish to produce his best. While this is important in industry, more than many firms realise, it is equally important in our home workshops. An attractive, tidy workshop, which is a joy to be in, is so much better than the drab and dismal places which so many of them are. I know anything is a thing of beauty in the eyes of an enthusiast, if it is concerned with his hobby, but degrees of enthusiasm vary, and there are times when we can all do with that extra bit of uplift which comes from the correct use of colours.

Grey seems to be the universal colour in engineering—maybe because it looks the same whether new or old, dirty or clean. It has its uses here and there, but not for the all-over greyness which is the common appearance of many workshops.

Having the working parts of a machine the same colour as the job causes unnecessary eye-strain. Parts which work against each other cannot be coloured, but it is worth while painting all surfaces possible around the working area in a bright colour so that the eye will be quickly focussed where it is needed and the job stand out against the background. A cream or stone colour is good for this purpose.

The less important parts of a machine need a restful unobtrusive colour, and the common grey has some value here, although people who have made a scientific study of the subject favour a fairly deep green as a background colour. In support of this they point to the widespread use of green in nature.

Too often the walls and ceiling of the workshop are given a coat of whitewash, which is too glaring in most cases, and when it collects its quota of dirt it can hardly be described as attractive. Walls facing you as you work should be restful and not in violent contrast to the colour of the machine—say, a pale green. Other walls, out of your normal working view can be used to reflect light. Cream or yellow is better than white in these positions. A plain ceiling may be white to get the best light reflection, although cream matching the walls may be better. Distemper can be had in a large range of shades, but a gloss paint will have a harder and cleaner surface.

If the "ceiling" is broken up by a mass of trusses and beams, a pale blue for everything gives the best effect. This colour is the most "receding" and does not attract attention.

Red should be reserved for danger marking. It attracts more attention than any other colour, and should be kept for switches, fire extinguishers and similar things. A club workshop should be very colour conscious. With a number of people working fairly close to each other, any self-respecting club should aim to make the working and safety conditions rather better than the average factory. Yellow is another colour which demands attention and this could be used to outline working areas around machines. If there is some obstruction against which people are always barking their shins, paint it with black and yellow stripes, then you will have made it as obvious as possible.

Orange is also highly visible and is a good colour for indicating anything out of place. The wrong side of safety covers, switchboxes, etc., could be orange. If tools are stored on racks the background could be dark, with the outline of the tool in orange. Any orange visible in the workshop shows that a flap is open, a tool is missing, or something is not as it should be.

In the Workshop...

REPAIRING MOTOR-CAR COMPONENTS

BY DUPLEX

THE alloys of which some carburettors used to be made seem to have the peculiar property of changing shape, or even altering their dimensions, after being machined. As a case in point, a friend recently complained that the performance of his car had much deteriorated, as slow-running had become irregular, starting was difficult, and acceleration was not what it used to be.

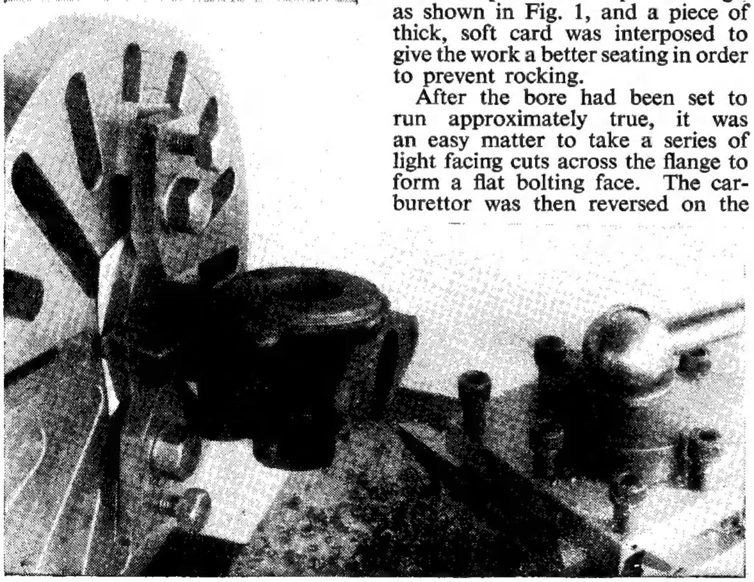


Fig. 1. Machining the carburettor flanges on the lathe faceplate

These symptoms rather suggested an air leak in the induction system and, sure enough, it was found that oil squirted on the joint between the carburettor and the cylinder block was at once sucked in while the engine was running slowly.

On removing the carburettor, it was evident that a garage had, at one time, tried to cure the leak by fitting no less than three fibre washers. A rule placed across the carburettor flange showed that the abutment surface was concave to the extent of nearly $\frac{1}{16}$ in. Although the flange could have been trued by filing, it was decided to machine the surface flat.

As it happened, the opposite flange was also concave, but to a lesser extent; this flange was, therefore, first trued in the lathe to provide a flat bolting surface for machining the second, more important, flange. For this purpose, the carburettor body was secured to the lathe faceplate with a pair of dogs, as shown in Fig. 1, and a piece of thick, soft card was interposed to give the work a better seating in order to prevent rocking.

After the bore had been set to run approximately true, it was an easy matter to take a series of light facing cuts across the flange to form a flat bolting face. The carburettor was then reversed on the faceplate and the second flange machined flat.

After the carburettor had been replaced by bolting it down on a paper washer soaked in linseed oil, slow running became quite regular and the car's original performance was fully restored.

An instance of an alloy carburettor part apparently growing in size happened some years ago. This carburettor was furnished with an alloy piston moving in a dashpot under the influence of the negative pressure set up in the induction pipe. Trouble was experienced with the piston sticking in the raised position and making starting impossible, so much so that the cap over the piston was removed and a pencil was kept in the pocket for pushing the piston down before attempting to restart the engine. When time allowed, the carburettor was dismantled and the piston and cylinder carefully examined and measured. It was found that both the piston and cylinder remained circular, but either the piston had increased in diameter or the cylinder had shrunk. The remedy was simple: the piston was mounted by its guide-rod in a draw-in collet fitted to the mandrel of a precision lathe, and a cut, five thousandths of an inch deep, had to be taken over the surface before the piston would move freely in its working cylinder.

However, this was not the end of the story, for it was found that

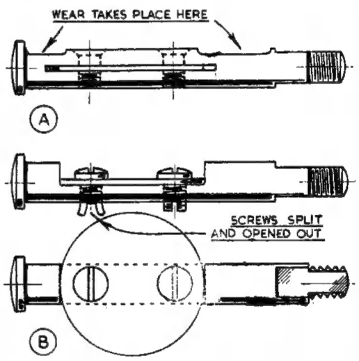


Fig. 2. "A"—the worn throttle spindle; "B"—method of fitting a new spindle

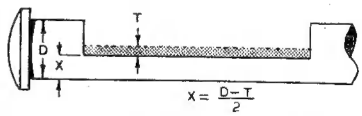


Fig. 3. Preparing the seating for the throttle disc

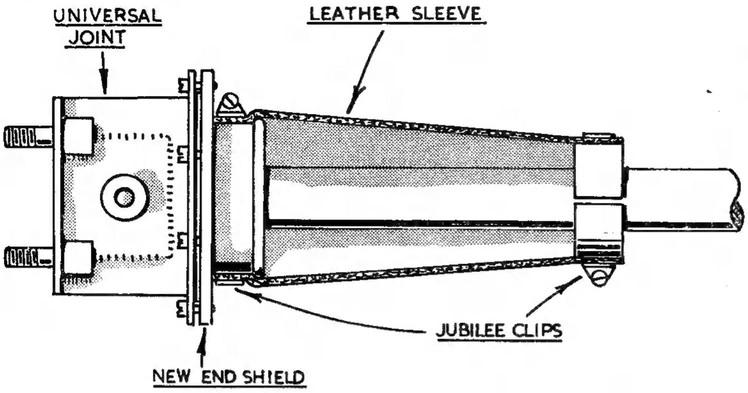


Fig. 4. Showing the new universal-joint cover in place

this machining operation had to be repeated each year when the car was again put on the road after having been laid up for the winter.

The explanation of this trouble, we are told, is that some alloys formerly used in carburettor construction had a crystalline structure, which was in itself unstable, and this in course of time gave rise to an actual growth or deformation of the metal.

Fitting a Throttle Spindle

When, as illustrated in Fig. 2A, the spindle of a butterfly throttle becomes seriously worn, a permanent air leak is established in the induction system. This may be sufficient to impair the slow running of the engine and may also upset the standard setting of the carburettor.

Wear of the spindle is often aggravated by vibration, and if the bonnet is raised and the engine speeded up, the spindle, together with its control rod, may be seen to rattle and vibrate. This vibration can usually be checked by fitting a coil spring to steady the parts and keep them under tension.

Presumably to prevent rusting, throttle spindles are generally made of brass rod, but a stainless-steel spindle is preferable and will be less subject to wear. The standard throttle spindle in question is slotted about its diameter to house the disc throttle ; this would entail a rather troublesome job in the small workshop, for the slot would probably have to be milled on either side of the spindle with a small circular saw and then squared at its ends with a warding file, or by using a hacksaw blade of the correct thickness. The new spindle is, therefore, milled or filed down to the half diameter, plus half the thickness of the throttle disc, as represented in Fig. 3. It is important to mount the disc with its centre-line on the centre-line of the spindle, otherwise the throttle will not open and shut correctly.

If stainless-steel is used, the spindle when cut down below the diameter, will remain fully strong for its purpose.

Before turning the spindle to size, the bearing holes in the carburettor body should be reamed to restore their circular form, for these, too, will often be found much worn.

As shown in Fig. 2B, there is now room to fit round-head screws for attaching the disc to the spindle. To lock the screws in place, their shanks are slit so that they can be opened out with a screwdriver after the parts have been carefully assembled in the carburettor body.

A Universal Joint Cover

Difficulty was recently experienced in obtaining a satisfactory replacement cover for the rear universal joint of an Austin Seven propeller shaft. The damage to the original cover was probably caused by the increased angularity of the propeller shaft, following the fitting of supplementary springs to the back axle for increasing the load capacity of the back seat.

It was therefore decided to make a new cover from a sheet of pliable leather. The forward end of the cover fits on to the standard split collar surrounding the propeller shaft, and the assembly is secured in place by means of a Jubilee pipe clip, as shown in Fig. 4.

For securing the rear end of the cover to the body of the universal joint, a new end-shield was turned in the lathe and recessed to fit over the flange or lip formed on the forward end of the body. As shown in Fig. 5, this end-shield is held in place by means of a split-ring or divided pressure plate fitted with six screws. The rear end of the leather cover can then be secured to the spigot on the end-shield with a second Jubilee clip.

Repairing a Hand Brake

In the brake lever illustrated in Fig. 6 the ratchet pawl had opened out the lower end of its housing bracket and, as the pawl tilted under

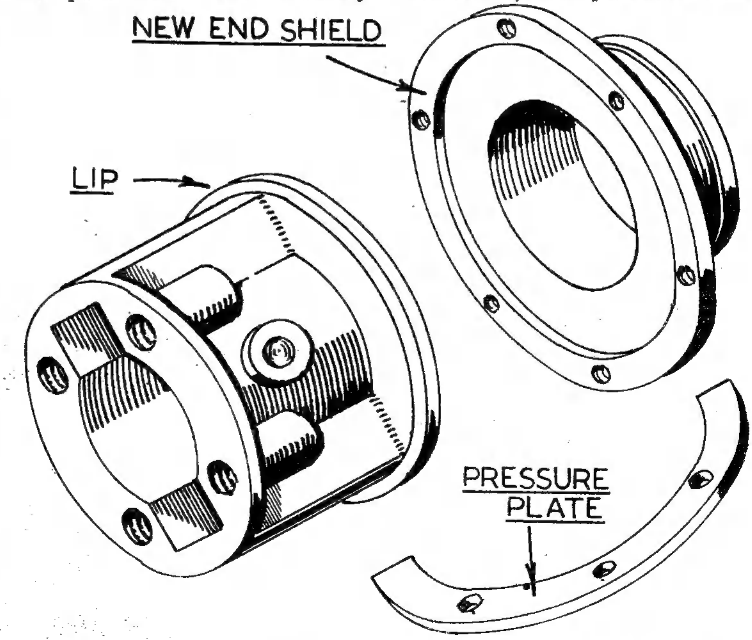


Fig. 5. The fitting used for attaching the rear end of the cover

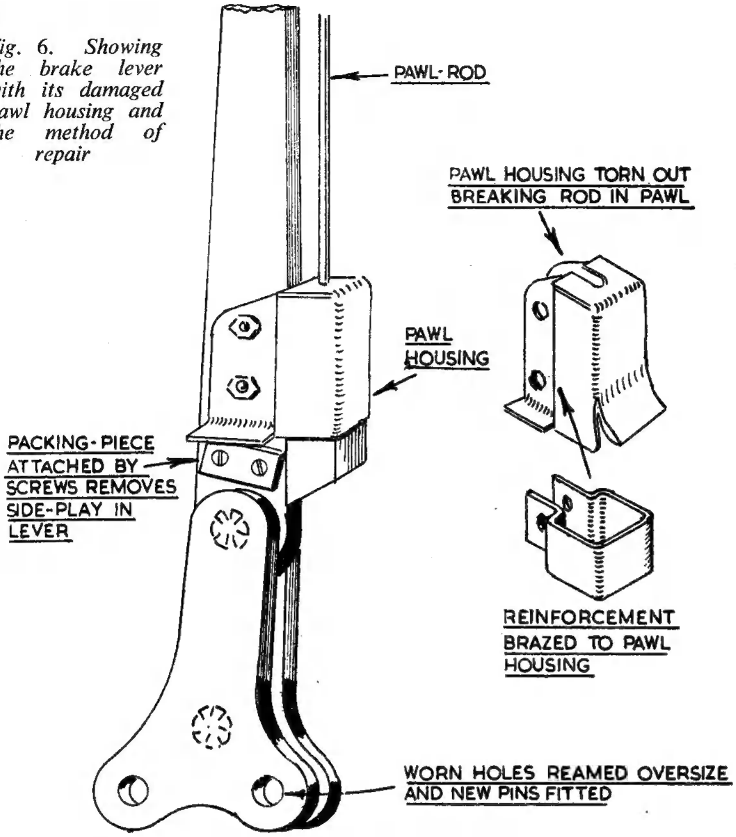


Fig. 6. Showing the brake lever with its damaged pawl housing and the method of repair

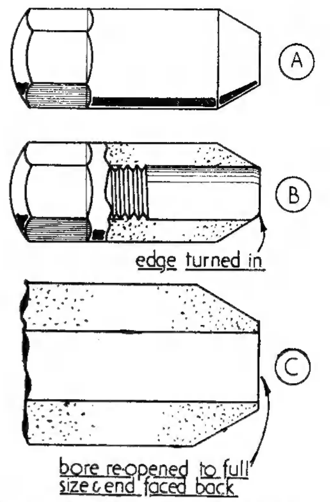


Fig. 7. "A"—a barrel wheel-nut; "B" the contracted bore; "C"—the remachined nut

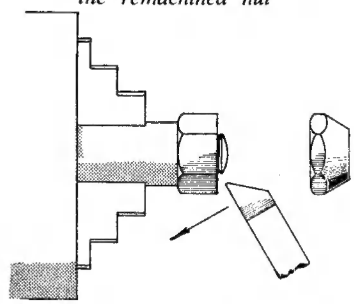


Fig. 8. Forming the taper on a temporary wheel-nut

the braking pressure, the pawl-rod itself became broken off at its lower end.

Possibly, the mechanism would be strengthened if, with the brake in the on position, the pawl were pressed against the solid side of the lever and not against the sheet-metal bracket.

The bracket was repaired by first hammering down the bent portion into place and then making a reinforcing clip to fit closely over the lower part of the pawl housing. The clip is also cross-drilled for the lower attachment bolt. After the parts have been well-cleaned and then assembled with the bolt holes set in line, the clip is permanently fixed in place by brazing with "Easyflo" silver-solder. To finish the repair, a new pawl-rod was fitted. As there was excessive side-shake in the brake lever, a packing-piece was attached to the side of the lever to make it a fair working-fit in the gap between the two ratchet plates. Lastly, the worn pivot holes were reamed oversize and new, hardened pins fitted.

While on the subject of the hand brake, how many motorists one hears applying the brake by merely pulling back the lever with the pawl riding on the ratchet bars. This not only causes unnecessary wear, but also makes it more difficult to release the brake quickly in the event of a skid following an emergency application. Surely, the right way to put the brake on is first to raise the pawl and then to allow it to engage quietly after the brake has been fully applied.

Trouble with Wheel Nuts

The long, barrel-shaped wheel nuts illustrated in Fig. 7 were largely used on cars that are now out of date.

Nuts of this type were probably discarded because of the trouble they often gave after being in use for only a short time.

The illustration shows that the plain part of the bore slides over the threaded end of the stud before the nut threads engage.

In time, as shown in Fig. 7B, the chamfered end of the nut becomes contracted from pressure against the wheel, and removal of the nut is then difficult. As represented in Fig. 7C, this trouble can be largely overcome by opening out the bore of the nut to its original size, and then refacing the end so as to leave a sufficient thickness of metal at this point to resist subsequent distortion.

A motorist friend recently called late at night saying that his car had developed a wobble which made steering almost impossible.

The reason for this was at once apparent, for one front wheel of his ancient Austin was held by only a single nut, and that was loose. A temporary repair was, therefore, made to enable him to get home in safety. As the wheel studs were threaded $\frac{3}{8}$ in. B.S.F., three standard nuts of this size were used for making the emergency set. These nuts were just long enough to hold the wheel and, at the same time, to afford a grip for the standard wheel brace. A $\frac{3}{8}$ in. threaded stub mandrel was gripped in the self-centring chuck and, by setting over the lathe top-slide as in Fig. 8, the nuts were in turn machined with a taper corresponding to that on one of the remaining wheel nuts.

TWIN SISTERS

by J. I. AUSTEN-WALTON

IN presenting this general arrangement of the boiler, I do so with great confidence ; for one thing, the design is quite orthodox, even if the method of construction does seem a little different from the types we have become accustomed to seeing in recent years. This method of building a boiler has many advantages not the least of these being its ease of manufacture.

As for its strength, we now know that a *properly* brazed boiler has joints that are as strong as, or even stronger than the parent metal, and advantage is taken of this fact to ensure that the finished article will withstand at least four times its normal working pressure.

Let me "build" this boiler for you, and you will see as we go along how many of the tortures are removed.

The Barrel

This is just a piece of solid drawn tube, $4\frac{1}{2}$ in. outside diameter, by 14-gauge thick. If the tube is thicker than this, it will not matter a bit ; in these days, one has to take whatever is available at the time, and be thankful for it.

Cut the barrel to the length shown, plus a little, and fit with a hard wood plug each end. If one of these plugs can be turned up to drive tightly inside the tube a little way, so much the better, for you will see that there is a slight bored recess to accommodate the front tubeplate. The process of turning up the barrel between centres gives a job that has perfectly true ends, and also ensures a true register with the throatplate that will, in turn, give us a finished boiler that is straight from end to end. In the case of a very thin-walled tube, the turned down portion may be purely nominal, and as long as it provides a register to support it in the throatplate during the brazing operation, nothing more is required of it. The same conditions apply to the bored-out end ; this supports the tubeplate by means of its narrow ledge inside.

Continued from page 70, January 15, 1953.

The Dome

The dome is a real one—not to be confused with the more ornamental dome cover that later fits on top. The hole for this may next be cut in the barrel, and the dome itself turned up from a piece of thick-walled copper tube. You will notice that it has a deep turned-down skirt that locates it in the barrel hole. Make this a very good fit, so that it requires slight knocking in to secure it ; also, see that the length of skirt does not interfere with the path taken by the main steam collection pipe that will run immediately under it. You may, if you like, cut away a little of the skirt locally to ensure good clearance here.

If the entire dome unit is made at this stage—that is, the top screwed ring as well, you may braze the dome in, and at the same heat, silver-solder the ring in place. In this case, start by setting the dome perfectly true in the barrel. Check with a square on the top of the barrel, and measure or sight it from the end view to get it correctly set in both planes.

The main brazing material for the entire boiler should be "Silbralloy," made by Johnson Matthey ; this needs no flux at all, or perhaps I should say, it is self-fluxing which is quite a different thing. Provided that enough heat is applied to the job, I imagine it would be virtually impossible to get a bad joint with it. Another thing in its favour, and a very important thing too—there is no sign of brittleness in the finished joint.

Finally, it has a melting point not very much above silver-solder and this is most useful, as you will see later. Use the "Silbralloy" to secure the dome to the barrel, having first fluxed the top ring for silver-solder ; you will then find the heat conditions just right for a touch of "Easyflo" after the first joint is done.

Throatplate

Although this is shown on the drawing, there was unfortunately no room to detail it like the backhead plate, and this will have to come, with other details, later.

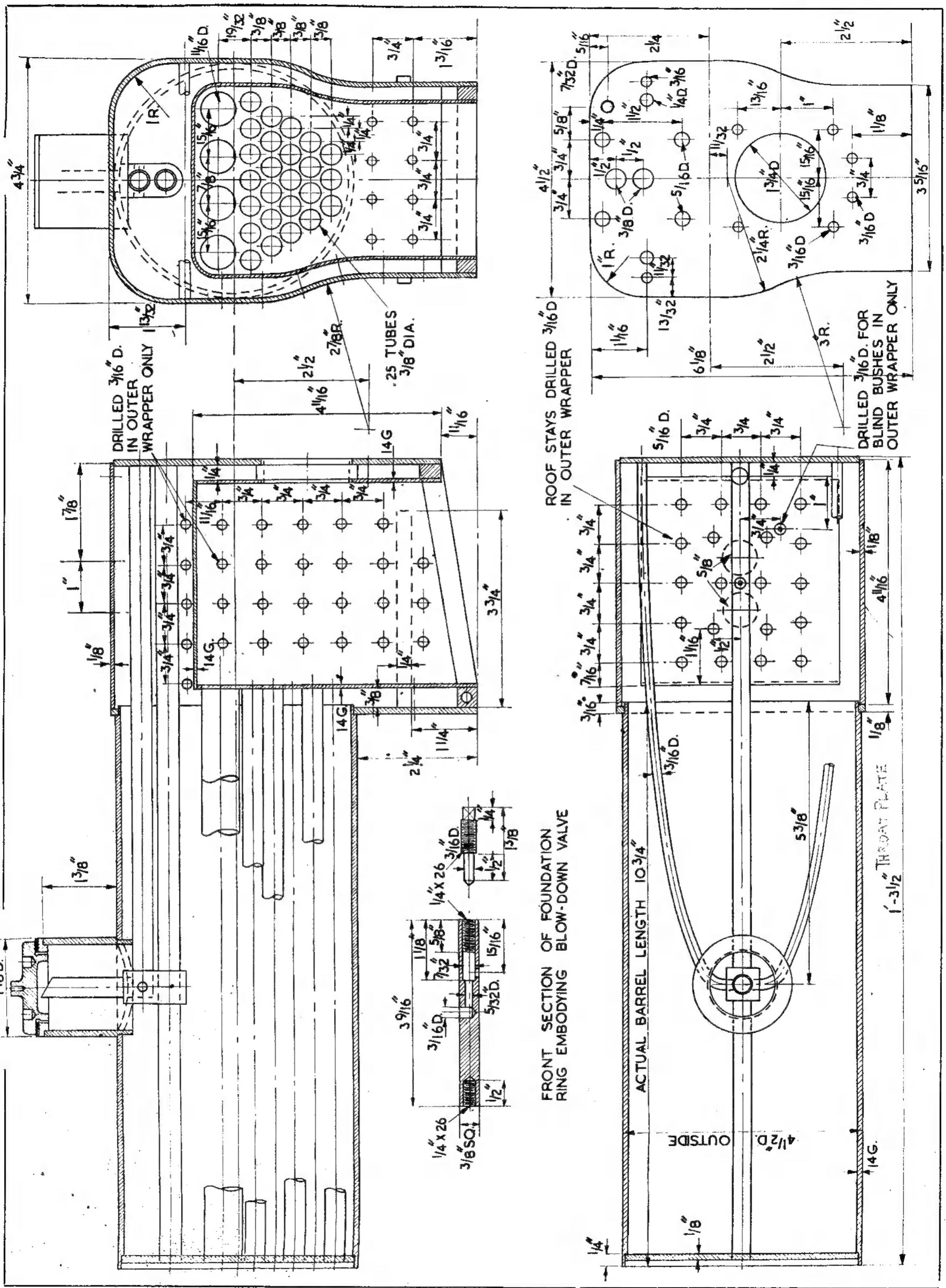
For the time being, we will discuss its making and manner of fixing, and drawing attention to one little thing. This plate does not go inside the outer wrapper in the usual way, but is butted against it as shown. This is a point to remember when cutting it out—it will be $\frac{1}{8}$ in. larger all round than the backhead.

After cutting out the plate outline, remove the centre portion and set it up on the lathe and bore it to fit over the turned-down spigot end of the barrel. Below the barrel aperture will be found two rows of stay holes ; drill these.

Outer Firebox Wrapper

This is in fairly heavy material, the reason for which I shall also give later. For the time being, give attention only to its cutting out and forming. The best way of doing this is to make up a wood block to the desired outline, and dress the annealed copper over it. Do not use a hammer unless it is made of rubber, rawhide, or wood ; but first of all, you will have to find out the length of the sheet. The best way of all is to take a paper strip and follow round the edge of the backhead plate, after the latter has been cut out ; as the backhead plate is shorter than the throatplate add about $1\frac{1}{2}$ in. to the total length to allow for the deepest part of the firebox. It is also a good plan to cut the sheet a little wider than the actual box length, afterwards squaring everything up when the bending has been done. You may now, if you wish, mark out and drill the roof stay holes, holes for safety valves, blind bushes and side stay holes, but personally I prefer to wait until the wrapper is brazed to the throatplate.

Now we can make up the front section of the foundation-ring. This is made to perform the function of blow-down valve as well. The advantage of so doing is that it is in the very best position for its job, this being the lowest part of the boiler, and the blow-down is taken from a very central point, in the middle of the boiler in the other aspect. The square-headed valve spindle is accessible from the outside, through the D-shaped opening in the frames, and actually takes the form of a wash-out plug as fitted to the prototype. The drilled and tapped hole at the opposite end of the fitting is merely to accommodate a dummy plug which will be visible through the other frame opening. It does not matter from which side the working plug is operated. The whole thing can be made up from a bit of square copper bar in a very short time, and when


DRILLED 3/16" D. IN OUTER WRAPPER ONLY
25 TUBES 3/8" DIA.
ROOF STAYS DRILLED 3/16" D IN OUTER WRAPPER
DRILLED 3/16" D. FOR BLIND BUSHES IN OUTER WRAPPER ONLY
FRONT SECTION OF FOUNDATION RING EMBODYING BLOW-DOWN VALVE
ACTUAL BARREL LENGTH 10 3/4"
4 1/2" D. OUTSIDE
THROAT PLATE

made, rivet it in a couple of places to the bottom edge of the throatplate. There is just room for two rivets without breaking into any drilled ways.

There are also a couple of strips to be made to form supporting runners for the boiler to sit on the top frame edge ; these, for the time being, may be riveted to the wrapper sides, but will ultimately be secured by brazing. The best time to fit these is when the boiler shell is partly made up and the boiler can be erected between frames, and the lines for the supports can be scribed directly on the wrapper sides.

The First Brazing Job

Take the boiler-barrel and stand it on its front edge. Fit the throatplate over the barrel spigot so that the attached foundation ring section (blow-down section) is on top. Take the outer wrapper and stand this on the top of the throatplate (also take care that, if any drillings have been made, the wrapper is the right way up). The throatplate should now show equally all round, and be flush with the wrapper edge. See that the throatplate lines up with the dome fitting on the barrel. It may be easier to knock over the projecting barrel flange slightly, so as to lock it firmly when its true position has been found, and so ensure that it will not move while you are positioning the wrapper on the throatplate. If necessary, drill and fit a number of tiny copper pegs to the throatplate, to locate the wrapper firmly in its right place.

And now for the heat ; for preference, the oxy-acetylene torch, of course, but failing that, a large gas-air blowlamp. Direct the flame inside the wrapper, and get some lengths of " Silbralloy " ready. As soon as the copper becomes red-hot, apply the rod in the gulley formed by the barrel spigot and the throatplate. From the outside, which is in complete and full view, you should be able to see the metal run right to the outer edges, and this is *very important indeed when building to this method.* On cooling down, a complete joint should be visible *everywhere* on the *outside*. The inside should reveal a good, even, round fillet of metal between the wrapper and the barrel spigot. It is not necessary at this stage to braze the foundation ring section in place, but no harm will be done if it is included in the first heat.

The Inner Firebox Wrapper

This is another case for a wood block for the forming of the wrapper, obtaining the sheet lengths and widths in the same way as for the outer wrapper. Now is the time to check up on the space left on the chassis between frames and stretchers and to make sure that the dimensions *agree with your job as it has been built*. If there are discrepancies on my side or your side, make a careful note of the alterations to be made to ensure that the boiler will drop in place when finished ; remember that a tight-fitting boiler will be no end of a nuisance to fit, so leave yourself " shaking " space, especially fore and aft.

Let it be assumed that the various stay holes have been drilled in the outer wrapper, and now you have to drill the corresponding *roof stay holes only* in the inner firebox. Mark these out with some care, remembering that they will tie up with the position of the entire inner firebox and firetube unit when built. Before we actually come to this operation, there is the firebox tubeplate to make. This, like the other plates, is in flat form. Both the tubeplate and door-plate are to the same outline, but different in length like the outer wrapper front and back plates ; you may, if you like, adopt the same procedure as for the outer wrapper, making the tubeplate butt against instead of going inside the wrapper, but as we cannot adopt quite the same procedure for the brazing operation, the gain in time or convenience is not to be counted for much.

My own method of dealing with this part of the job, is as follows :—The tubes are all cut to length, and faced both ends in the lathe. The tubeplate is cut out and drilled for the tubes which are now up-ended and inserted in the plate, leaving a very slight tube projection through the plate. As a rule, the mass friction of the whole bank of tubes in place is enough to prevent the plate sliding down during the brazing operation ; but to make sure that no movement takes place, the tubeplate may be packed up from both sides on bricks, leaving the bank of tubes supported lower down. The wrapper is now stood on the tubeplate (if made to method No. 1) or the wrapper is fitted with a number of tiny copper pegs to prevent its movement down and over the tubeplate. The flame is now brought to bear *inside* the wrapper, and the brazing-rod run round the tube ends and the wrapper edge as well. This is such a very simple thing to do that I simply cannot understand how anyone can make a mess of it. I have never in my life burned a tube, or got anywhere near to it.

Coming back to the tubeplate, I usually make this and the other tubeplate at the same time, drilling through both plates in one operation. The barrel tubeplate, when drilled, provides holes by which it may be bolted to a faceplate on the lathe, and it may then be turned to the exact size required ; in our case, this would be a nice easy drop-in fit to the barrel, where it will sit comfortably on the ledge turned for it.

We have not quite finished with the firebox tubeplate; this also has two rows of holes for stays, mating up with the throatplate. The obvious thing is to drill these stay holes together, before anything is brazed up, so make a note of it. Normally, one would go on to make and fit the door-plate, but not in this case. Assuming that the nest of tubes, tubeplate and inner wrapper are made and brazed, now drill for a number of copper pegs at the other end, so that the door-plate will have something to rest on when its turn comes.

Door-Plate and Firehole

Cut out and drill the door-plate with all the holes shown, turn up the firehole and leave it round, On the prototype, the hole is so very nearly round that I decided to leave it so; the actual firehole door is of just the right proportions to cover the ring completely, and the access is very good when the door is open. Put the parts made to one side, and now turn back to the inner firebox, offering it up to the outer barrel complete with front tubeplate. I know it is no end of a fiddle threading all the tubes into the plate, but I find if they are carefully set beforehand, and the tube holes are not too tight, that it does not take more than about ten minutes at the outside; it also proves everything for final assembly later.

With all this in place, take a cramp, holding the firebox tubeplate firmly to the front section of the foundation ring. Now is the time to check off the roof stay drillings with the roof or crown of the inner box. It is possible to drill these through from the top set of holes, afterwards removing the inner unit, but remember that the inner set of holes is smaller, and has to be tapped 2 B.A. A good intermediate course would be to start a $\frac{3}{16}$-in. drill in every hole, afterwards removing the inner shell and completing the drilling in the proper size, followed by tapping all round.

Most important of all, with this temporary set-up, make sure that the inner unit is fair and square from every aspect, especially from

(*Continued on page* 143)

READERS' LETTERS

Letters of general interest on all subjects relating to model engineering are welcomed. A nom-de-plume may be used if desired, but the name and address of the sender must accompany the letter. The Managing Editor does not accept responsibility for the views expressed by correspondents.

THE STATIONARY ENGINE

DEAR SIR,—In his notes ("M.E." Nov. 6th, 1952) "B.G.J." states that in the Tangye engine illustrated there is no support for the end of the trunk guide.

Now, this engine had a box frame, of one casting, to contain the guides for crosshead and valve-rod, and to enable the whole to be erected without any special setting out, except to have the crankshaft

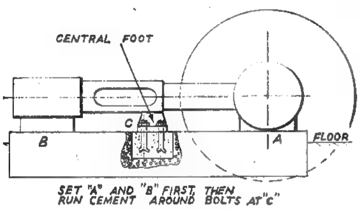


Fig. 1. Sketch showing fixing of Tangye type engine on foundation of stone or concrete

in its proper position. The feet beneath crankshaft and cylinder were set first, then the two or four bolts being screwed up tight in their holes, reamed in the central foot (shown in the air as photographed) cement was run round the bolts, giving a positive support for the whole frame in addition to the trunk guide. (Fig. 1).

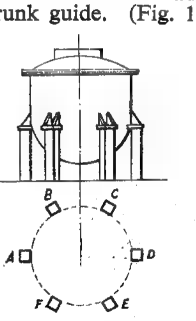


Fig. 2. A chemical vessel on six pillars. Set up on A, C, and E, then fix pillars B, D, and F

In a case of this sort, any attempt to pull down a foot to bolts already set, would distort the whole frame; the same applies to any large vat or kettle upon six pillars; it should stand as a tripod, upon three of its feet, then set the other three (Fig. 2).

The Tangye engine shown in B.C.J.'s illustration is on an erector's bed in the works, not installed for running, when it would be upon concrete or stone.

If a knock is heard in a trunk guide, there may be a very serious cause for it, if the connecting-rod brasses have been adjusted, or scraped, the rod may be, in effect, shortened by a very small amount, when, if a ridge due to wear has

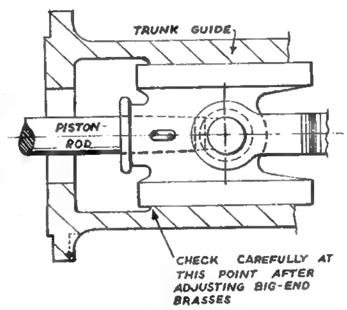


Fig. 3. Examination of crosshead at back dead centre after adjusting brasses

formed in the crosshead or its slipper, the part of the slipper which has not worn will hit the back end of the trunk guide. Owing to the darkness inside a trunk guide, this fault may escape notice; after altering the brasses on any engine, this point must be very carefully watched (Fig. 3). Of course, if the brasses should be new, so that the effective length of the rod is increased the fault mentioned will occur at the front end of the guide.

For details of engine parts, etc., get a copy of "Machine Design, Construction and Drawing," by Spooner, 1908 and subsequent editions.

Yours faithfully,
London, N.W.7. H. H. NICHOLLS.

LOCOMOTIVE HEADLIGHTS

DEAR SIR,—As an engineman I was interested in your reference to a letter received from "Progress" about electric lighting on locomotives. I certainly think the type of headlamp carried by Canadian and American engines would not be suitable in this country, but neither are they necessary. All that is required is a small electric light similar to those fitted to *ex*-L.N.E.R. engines to indicate the whereabouts at night time for those who have to work on or about the track. The present outdated system of oil lamps is quite unreliable, as they are more often out than in. Stand at any busy centre—I am referring to the N.E. Region—during the hours of darkness, and at least 50 per cent. of the trains are running with headlamps out. Incidentally, this also justifies a theory of mine that the continued use of the headlamps code on locomotives is not necessary. I have particularly noticed at night time that the through brakey has been given the through road and that the express due to call has been turned into the correct platform road despite not having headlamps lit. Another reason for electric lighting is the reliability for lighting the water-gauge. The oil lamps used for this purpose blow out nearly before the engine has made two exhausts in backward running. I have on many occasions had to use the permanent way programme to reflect the light from the firehole to see the water level in the boiler and on two occasions at least, THE MODEL ENGINEER has been used.

I like the "words and music" of "L.B.S.C." and his lobby chats and following his words and music I have built a three-cylinder tank engine $3\frac{1}{2}$-in. gauge L.N.E.R. V1 with Gresley two-to-one gear for the middle cylinder. I had only blueprints for the valve-gear; all the other parts were built up without drawings and what snags I encountered! The model is not a masterpiece by any means, but I am looking forward to trying her out on the Bishop Auckland track.

Yours faithfully,
Crook, Durham. J. CLARK. (Driver.)

THE G.E.R. "DECAPOD"

DEAR SIR,—Referring to the letter from Mr. A. H. Carter, if he would care to get into direct touch with me, I shall be very pleased indeed to do what I can to help him, as I have fairly comprehensive data and drawings of this historic and most interesting engine.

Yours faithfully,
Rustington. K. N. HARRIS.

East Anglia's first steamboats

Some facts and speculation on the vessels and power plants

By Ronald H. Clark, A.M.I.Mech.E.

IT is not generally appreciated that the River Yare has the distinction of being one of the very first English rivers upon which steam navigation was tried and used in the early part of the last century. It was in 1801 that Symington ran a steamboat on the Firth & Clyde Inland Navigation Canal, in 1807 that Fulton introduced steam propulsion between New York and Albany and only six years later in 1813 the first steam vessel was seen on the River Yare between Yarmouth and Norwich.

It happened in this way: A public spirited Yarmouth gentleman, Mr. John Wright, a Quaker, purchased for £35 from the Government a captured French privateer *L'actif*, which was in effect an open rowing boat accommodating 20 oars, three lug sails, was clinker-built, 52 ft. long and of about 10 tons burthen. At first a crude form of gas engine was tried using hydrogen mixed with air as the combustible mixture but this proved quite costly and unsuccessful.

By this time, Richard Trevithick, perhaps the greatest engineer of the last century, the father of high-pressure steam and the builder of the first successful railway locomotive in 1804, had also designed and developed his "high-pressure" steam engine and had entered into an agreement with Fenton, Murray & Wood of Leeds for its manufacture; the partner, Matthew Murray, being another engineering giant of the period and known as the Father of Leeds Engineering and the inventor, among other things, of his hypocycloidal straight line motion and the common slide valve. Their fame had spread to Yarmouth, news sometimes travelled faster by sea in those days, so it is not in the least surprising that *L'actif* under the control of Mr. Richard, brother of John Wright, was sailed from Yarmouth, round the North Norfolk coast, up the length of Lincolnshire and finally along the Humber and so to Leeds where at the Canal Basin in Water Lane, Murray & Wood installed the latest Trevithick engine, boiler, shafts and paddles, all made in their Round Foundry at Holbeck. Now it is one of the tragedies of "engineering" history that although the contemporary report tells us that this famous engine was of 8 n.h.p. having a single cylinder 8 in. × 30 in., no details of its configuration are traceable and therefore its precise layout is one of partial conjecture.

I say "partial conjecture" because, although a design for a Trevithick marine paddle engine is preserved in the Goodrich Papers, it was a proposed machine by John U. Rastrick, of Bridgnorth, whereas the engine under consideration was built by Murray and it is quite correct to assume that as Murray and Trevithick were great friends, the latter would be the first to agree to his friend applying any up-to-date improvements to an engine initially laid out by him. Now the most obvious improvement would be the substitution of the slide valve invented by Murray in 1802 and later improved by him, for the form of plug and cone valve hitherto used by Trevithick on his engines. One can imagine a friendly talk between these two geniuses upon this very subject, and Trevithick, with his great and co-operative mind, agreeing with Murray's proposal to use the slide valve on the engine for *L'actif*. Fortunately, a Murray engine of this very period is preserved in private possession and as I have made a model of it, the details of the valve gear are readily applied to the Bridgnorth engine to form the Leeds-made engine on Trevithick's plan now depicted in Fig. 2. Trevithick's original layout comprising the cylinder inclined on the boiler, the crankshaft actuated by two side-rods and large flywheel are retained, the salient modification being the Murray slide-valve and ports. In Fig. 3 are shown the details of Murray's share in the design from the hypocycloidal engine.

The boiler was "six or eight feet long and four feet diameter" of wrought iron with cast-iron ends. Only the sea portion of the voyage was covered by insurance, on the condition that the paddles were unshipped and the engine not worked! Unfortunately, on leaving the Humber *L'actif* encountered a fierce gale and was driven ashore on the North Lincolnshire coast. Mr. Richard, not to be beaten, shipped the paddles, got up steam and managed to refloat her on the next tide and got well out to sea, later, in view of the insurance, dispensing with steam and finally making Yarmouth under sail.

Arrived at Yarmouth, the name *L'actif* was changed to *Experiment* and on Monday, August 9th, 1813, a trial trip was made, with Sir Edmund and Lady Lacon and friends as the principal guests, and the "steam packet boat" successfully negotiated the tidal hazards of Breydon Water and returned to the Haven, to the great acclamation of thousands of collected spectators. The next day, another trip was steamed the whole way to Norwich, arriving there at 2 p.m. at Sandling's Ferry after a voyage lasting five hours and a half, the *Experiment's* normal cruising speed being "five miles per hour."

Five days later, on Saturday, August 13th, 1813, the *Experiment* commenced a regular passenger service between Yarmouth and Norwich, departing from Turner's Bowling Green at 7 a.m. and leaving Norwich every afternoon at "3 o'clock precisely."

Apparently, the service became very popular and it was maintained until 1817. It must be remembered that there was no railway between Norwich and Yarmouth at this period, and the river trip would be more of a novelty than travelling by coach, and the *Experiment* was certainly never liable to attack by highwaymen! The Trevithick engine proved very satisfactory and at times would propel the boat to 10 or 12 m.p.h., and it is interesting to note that the working pressure is recorded as "about 30 pounds per square inch," which fact will be mentioned again later.

This engine enhanced the builder's reputation so well that on the strength of it a stationary beam engine was supplied later by Fenton, Murray & Wood to a flour mill at Barningham, Suffolk, where it

worked regularly until 1930, when shortly afterwards it was sold to Henry Ford and is now preserved in his museum at Detroit.

But to resume. So successful had this project proved that in the following year John Wright built a new steam boat at Yarmouth and called it the *Telegraph*. It was powered by another Trevithick high-pressure engine, this time of 10 n.h.p.; but here again, no precise details have come to light although there is little evidence that it differed from the first. Shortly after the launch of the *Telegraph*, another vessel was laid down at Yarmouth and launched as the *Courier* and to it were transferred the engines and boiler out of the old *Experiment* and of which nothing more was heard; so we can conclude it became a mere hulk on some ooze bank. It is known, however, that Mr. Wright exhibited at Yarmouth a model of the paddle wheels he was fitting to the *Courier*, that they were of the feathering type and later this form became universal. During this period the *Telegraph* steamed round to the Medway and cruised about that area for a couple of months and then returned to Yarmouth. This trip to Kent was the first proper sea voyage ever made by a steamboat.

After its return, one cast-iron end plate of the boiler was found to be wasted by corrosion, due to the sea water used as boiler feed; so a new cast-iron end plate $1\frac{1}{4}$ in. thick was bolted into its place, and this end plate faced towards the stern of the ship. Note particularly that this repair was not carried out by the makers, but locally somewhere in Yarmouth, a fact which has a great influence on a tragic event to be described later.

Towards the end of 1816, Mr. J. Watts, who had a slipway close to St. Faith's Lane in Norwich, built a small packet boat called the *Nelson* and installed in it a steam engine; but who made the engine and boiler is now impossible to say. Although Watts was described as an engineer, it is unlikely that this engine was made in any but one of the five or six works in the whole of the country making steam engines at this early period, for one must remember it was 13 years before Stephenson created his famous *Rocket*.

The notable Toomland Fair at Norwich is held at Christmas and Easter every year, and at such a time there would be no dearth of passengers for a river trip; so Mr. Watts decided to inaugurate his competing service from Norwich to Yarmouth on Good Friday, April 4th, 1817, both the *Nelson* and the *Courier* starting from the old "Foundery Bridge" at the same time, viz. 9 o'clock. John Diggins, the engineman on the *Courier*, had resolved, however, to get away first and outpace his new competitor; so, to ensure a plentiful supply of steam for this purpose he had, according to one report, weighted the safety valve on the boiler with an extra 14-lb. weight! After moving off for about twenty yards or so, the new and imperfectly fitted cast-iron end plate, overstressed by a pressure never intended by Trevithick (pioneer of high-pressure steam that he was), blew out in fragments towards the stern. The great force of the explosion unseated the boiler and the engine with it, and large pieces were blown right through the fore and aft cabins. John Diggins, who was standing over the boiler and in the act of fastening a "skrew" when the explosion happened, was seriously scalded and lifted clean into the River Wensum but swam ashore. A steward standing over the boiler was projected upwards and finally descended unhurt to the lower deck where the boiler had been a few seconds before! Of the 22 passengers eight were found dead, one child missing and six other people were taken to hospital thus forming the first casualities ever handled by the Norfolk & Norwich hospital due to a boiler explosion. Although little was left of the boat save the keel and flooring, an infant was found asleep on the remains of the deck. William Nicholson, the steersman, was amongst those killed.

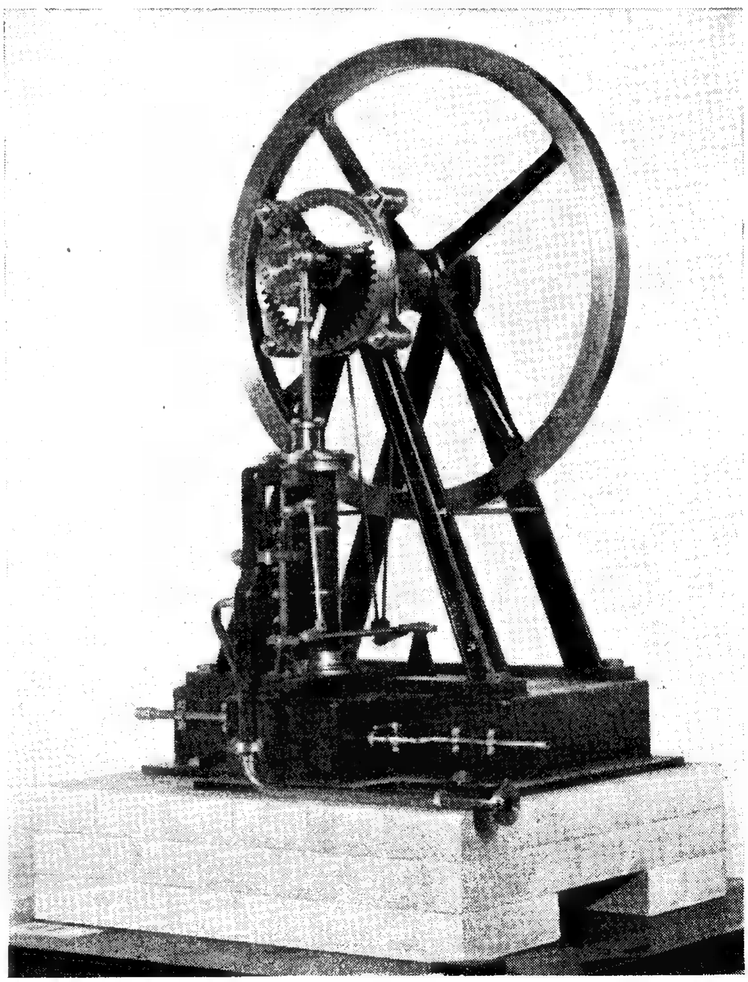


Fig. 1. A model of Murray's hypocycloidal engine by Mr. F. L. Folkard

Here it may be instructive to pause for a moment to appreciate that, even at this early period in newspaper journalism, the public were sometimes grossly misled over engineering matters, for the *Cambridge Advertiser* stated "... the weight which regulates the safety valve had not been applied before the starting of the vessel" ! Further comment seems so unnecessary.

Compensation for this disaster cost Mr. Wright, so it is said, about £10,000 and a fund was also opened for the victims. Another result was that a Select Committee of the House of Commons was set up to enquire into steamboat propulsion and published its lengthy report entitled "Report of the Select Committee appointed to consider the means of preventing the mischief of the Explosion of Boilers in Pleasure Steamers." House of Commons Paper 422, Session 1817, on the 24th June that year. This Report, lengthy and of folio size, is a typical government publication, although it certainly contains an amount of interesting data. Many witnesses were called, among them being Bryan Donkin, Timothy Bramah of Pimlico, John Taylor "Chymist" of Stratford, Essex, William Chapman of Newcastle-upon-Tyne, Henry Maudslay "Engineer residing at Lambeth," George Dodd, civil engineer of 8, Oxford Street, London, and Andrew Vivian, mining engineer of Camborne, Cornwall.

Bramah's evidence is very interesting, as he stated that he had examined the remains at Norwich and understood it was the cast-iron end plate which gave way, the remainder of the boiler being original and of wrought iron and was normally worked at 60 lb./sq. in. but probably exploded at 120 lb./sq. in. for it was only $\frac{3}{4}$ in. and a $\frac{1}{16}$ in. (i.e. $\frac{13}{16}$ in.) thick in some places.

Taylor stated he had control of a copper mine in Tavistock and had had constructed one of the first high-pressure boilers and used it in precisely the same manner as that in the Norwich boat. It was tested hydraulically to 100 lb./sq. in. and worked at 40 lb./sq. in. and later broke at only 20 lb./sq. in. He attributed the fracture to the unequal expansion of cast-iron and wrought-iron, and suggested "the use of lead to fill a hole drilled in the bottom where the fire acts." We have in effect the idea of the fusible plug and it is the earliest notice of it I have found.

William Chapman, of Chapman Locomotive fame, admitted he had three steamboats in the Tyne, and said the "boiler's bottom is liable to corrode or consume by the action of the fire and therefore requires watching"' This is one of the

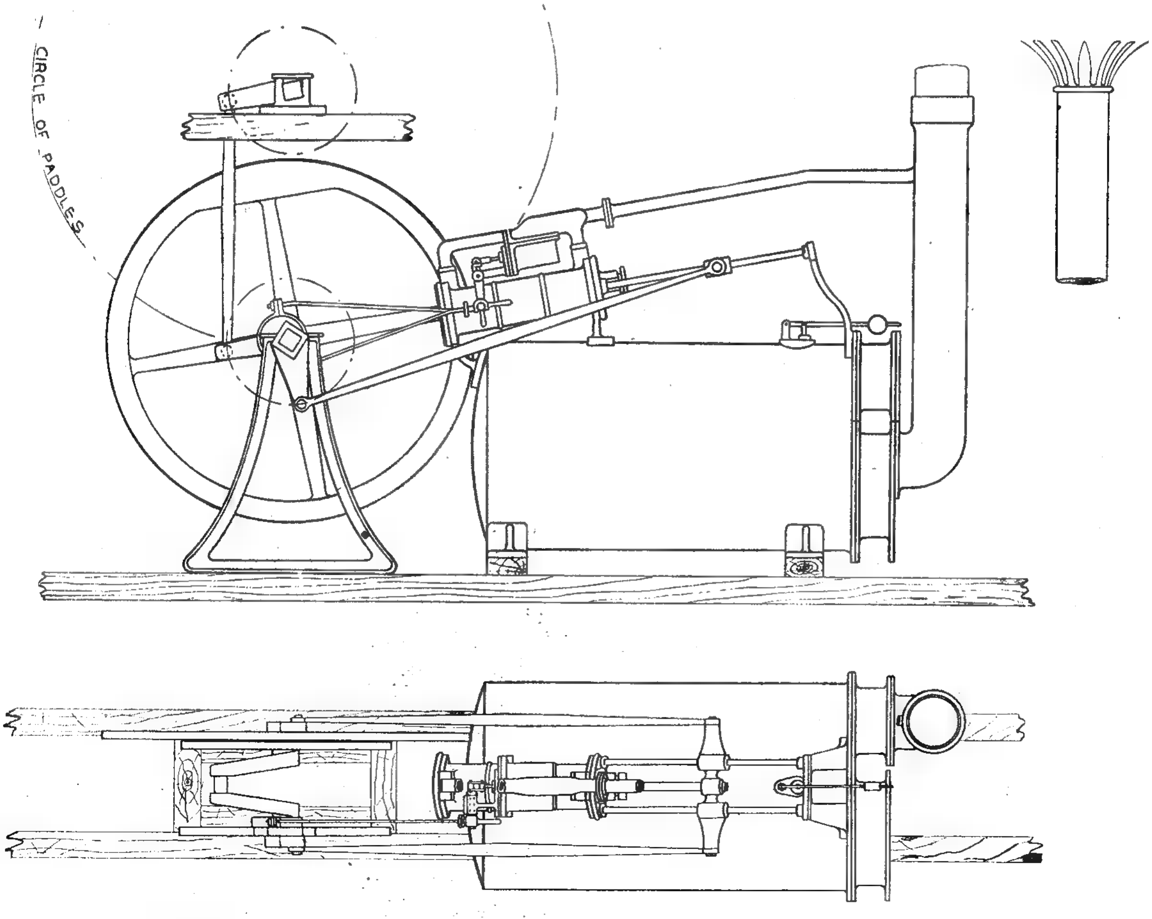


Fig. 2. Probable layout of the 8 *in. by* 30 *in. Trevithick-Murray engine in steam Privateer "L'actif"*—1813

earliest pleas for what has now become regular boiler inspection.

Henry Maudslay is known to many of us as the inventor of the table engine in 1807, and was later responsible for machine tools of many types and, after having been joined by his sons and a partner Joshua Field, the firm of Maudslay, Sons & Field became renowned for their engines for ocean-going paddle steamers for most of the last century. Fig. 4 depicts a model table engine in the author's collection typifying the type originated by Maudslay. In his evidence he emphasised the importance of fitting two safety valves to a boiler.

The evidence of George Dodd is particularly interesting as he said he owned five steamboats on the Thames and of these, two plied between London and Richmond, one between London and Gravesend and two between London and Margate. The *Thames* had been in use three years, the *Majestic* one year (London-Margate); the *Richmond* fifteen months (London-Richmond). Incidentally, *Thames* was a year old when he had her and she was steamed round from Scotland via Dublin and Land's End to London. He gave the cost of his boats from which it is interesting to note *Richmond* (probably only the second vessel built by Maudslays) cost £1,800 the engine accounting for £1,000 of this sum. He added that he went twice to Norwich with a view to buying *L'actif*, on the second occasion with two Germans from Bremen. Apparently, they did not buy because all the Norfolk boats used high-pressure steam. Such was the objection to anything greater than 5 lb./sq. in. in those days! Dodds also stated that he "found the shell (boiler) of the exploded boat riveted together." Thus we have definite proof that riveted and not bolted construction was used.

Andrew Vivian was a friend of Trevithick and supported the use of high-pressure steam.

After the Norwich explosion there could have been little public hysteria, for a contemporary report states that "Notwithstanding this shocking catastrophe, the steam packets were full of passengers on Monday." (That would be the Easter Monday.)

Again a notice appeared in the *Norfolk Mercury* for August 2nd, 1817, stating that a "steam vessel" (i.e. the *Nelson*) would ply between Norwich, starting from Mr. Brickwood's garden, and Yarmouth, and which had been approved by Mr. Charles Harvey, M.P., chairman of this select committee of the House of Commons. One most interesting

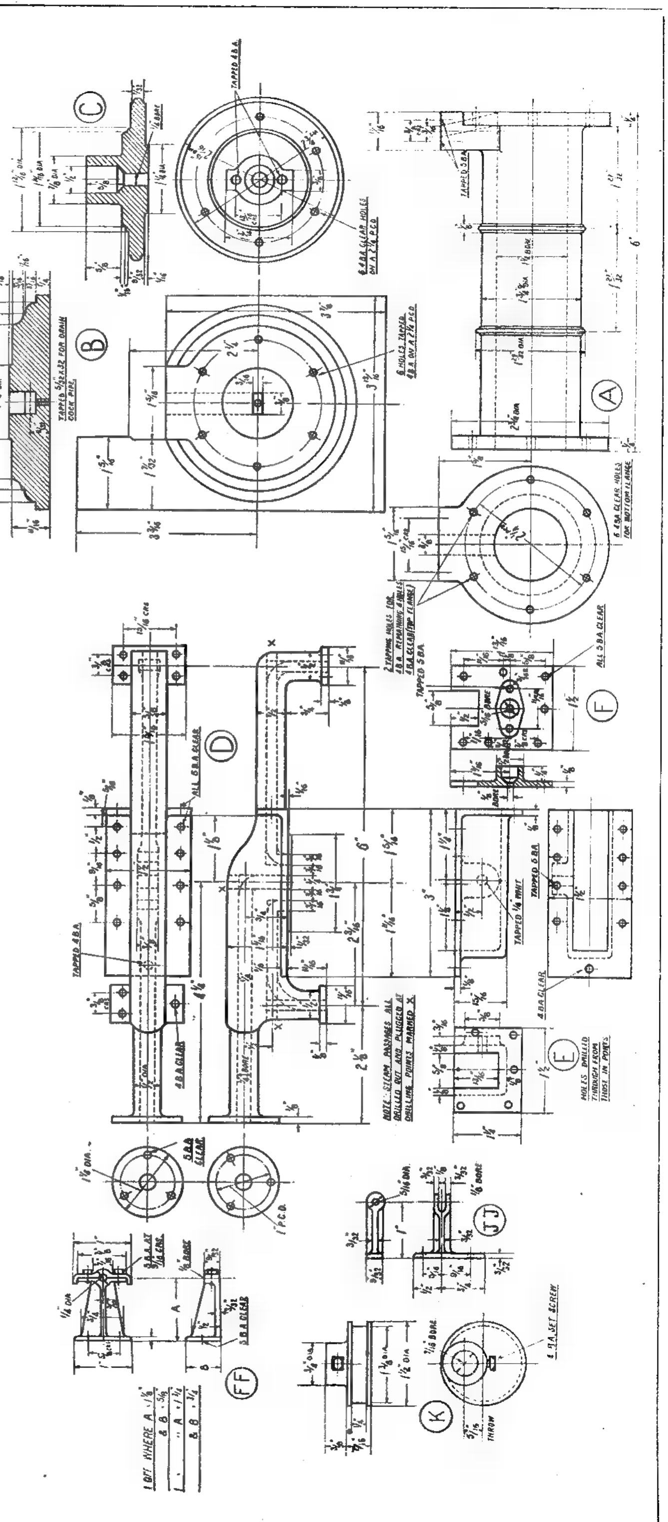


Fig. 3. Details of the cylinder, ports and valve chest of Murray's hypocycloidal engine

fact is contained in this notice, viz., that the engine is "a condensing engine," a fact which strengthens the probability of Mr. Watt's engine being of Leeds manufacture, for at this time Messrs. Fenton, Murray & Wood were applying the condensing principle to very many of their stationary engines. It is unlikely, however, that any degree of vacuum was obtained as the condenser was probably only a pipe fitted along the outside of the vessel into which the engine exhausted, thus eliminating the exhaust noise and reducing the back pressure.

To allay any possible fears still entertained by the river-going public, Mr. Wright, shortly after the disaster to the *Courier* had the engines taken out of the *Telegraph* and stored away. In their place a platform five feet wider than her beam and 18 ft. diameter was erected above gunwale level with a vertical shaft placed in the centre running in brass bearings and carrying a bevel toothed wheel at the bottom, just above gunwale level. The paddle shaft, which, of course, went athwartwise right across the boat, was retained and below the vertical shaft and had on it another bevel wheel meshing with the first. Four horses walked round and round on the platform thus actuating the paddles and propelling the vessel. In this queer guise the *Telegraph* continued on the River Yare under Mr. Wright's auspices for about a year, after which he sold it to Messrs. Tuck & Fisher, plumbers, of Yarmouth, who ran it as a passenger boat for three or four years, and then, the public prejudice against steam having abated, the stored engines and boiler were re-installed and the *Telegraph's* reversion was complete.

Besides the *Telegraph* and the *Nelson* plying between Norwich and Yarmouth as we have seen, there was another steam vessel which seems to be entirely forgotten, and this was the *Regent*. It was built by Henry Maudslay in the summer of 1816, in his works at Lambeth, at this time known as Henry Maudslay & Co. Henry Maudslay has stated that he built the vessel "for Yarmouth" and its boiler was equipped with two safety valves and with a sort of bell-pull to the engine room so that the engineer could pull it up as he pleased so as to keep it clear and in perfect order. The *Regent* was probably the third vessel to be built by Maudslays (we shall meet them again later) but nothing of her subsequent career at Yarmouth appears to be known.

Another pioneer steamboat to ply on the Yare was the *Defiance* which was in service in 1819, and is probably the vessel depicted in one of the views given in Preston's "Yarmouth." This had two boilers and an engine with a horizontal cylinder mounted on each end. She would do 5½ knots in still water and the two engines were rated at 12 combined h.p. Later, she went to the Thames.

The neighbouring River Orwell was also the scene of pioneering at this time, for on September 25th, 1813, there appeared in the *Ipswich Journal* an announcement to the effect that a steam packet would shortly pass between Ipswich and Harwich, "the arrangements are made" and due notice will be given in the same paper. There must have been some flaw in these arrangements, for on April 2nd, 1814, another notice appeared announcing that the *Orwell* Steam Packet will start from Mr. Seekamp's Quay near the Common Quay, Ipswich, at ten every morning and from the usual landing place at Harwich every afternoon at six o'clock. Parcels and goods could also be transported, provided they were booked in before nine in the morning at Ipswich and before five in the afternoon at the White Horse, Harwich. Exactly who the sponsors were in this case has not yet come to light, but their headquarters was advertised as the Steam Packet Office of Mr. Dowson's on the Common Quay, Ipswich, with agents at the Ship, Hibletts and the White Horse, Carrington's in Harwich. The fares are given, that of the best cabin 2s., and the small cabin 1s.

Again some hitch must have occurred in the arrangements for the next announcement is dated August 12th, 1815, when the *Ipswich Journal* reported that: "On Tuesday last about 2 o'clock, the Steam Engine Packet to convey passengers

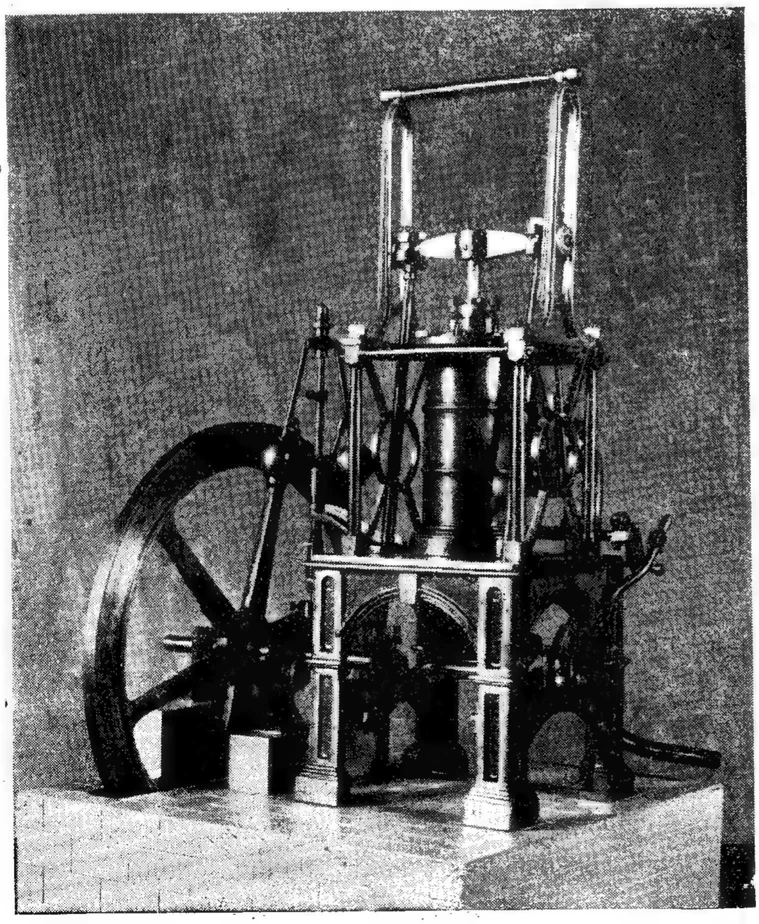


Fig. 4. *Model, dated* 1837, *of a typical Maudslay table engine*

&c., from this place to Harwich, arrived here with the Union Jack flying at the stern. A number of persons had been in waiting all the morning upon the Quay, in expectation of this long-expected vessel; the voyage from Harwich was made in about $2\frac{1}{4}$ hours. The cabin is neatly fitted up, and is very commodious."

Engine Too Small

The postponements were due to the first engine being found too small at private trials, and that which duly arrived on August 8th, 1815, was the second made. The vessel was [redacted] small flat-bottomed boat equipped with [redacted] wheel each side, each fitted with six frying-pan type paddles set squarely and without rims to them. This second engine which powered the boat on its first successful voyage to Ipswich, was of 10 nominal h.p. and both engine and boat were made by Henry Maudslay & Co., at Lambeth. As in the case of *L'actif*, on the River Yare, precise details of this second and successful engine are not to be found, although Maudslays are known to have adopted the side-lever layout originated by Robert Napier at this period. In all probability, this was the very first marine engine to be made by "Maudslays," although another by them was made and fitted this year (1815) in the *Richmond* (which we have already mentioned); so probably it will never be settled which boat had the honour to be the first so fitted. In any event, by September 16th, 1815, this small boat had commenced to ply regularly between Ipswich and Harwich, making one journey each way per day, the time taken for the 16 miles being usually $2\frac{1}{2}$ hours; but if against wind and tide three hours were required.

The service was maintained until October 21st, 1815, when another notice appeared in the *Ipswich Journal*, declaring that the proprietors of the steam packet boat inform the public that "it will cease to perform on the Ipswich River." They added that it was their intention in the ensuing spring (i.e. in 1816) to introduce a new boat "upon an improved principle." Unfortunately, nothing seems to be recorded to show that this new vessel ever made its debut upon the River Orwell.

Had the first engine been powerful enough, Ipswich would have been only [redacted] matter of weeks behind Norwich in the inauguration of its regular river service but the postponements caused it to be nearly two years. Ipswich and the Orwell were, therefore, [redacted] of the first East Anglian [redacted] to be connected with London engineering as Yarmouth had been with Leeds.

Another builder of engines for small ships at this period was the firm of Messrs. Lloyd & Ostell, who had premises in Gravel Lane, Blackfriars Road, London, and although proof is lacking it is probable they supplied engines and boilers to several of the East Anglian boat owners in the years immediately following. The partners were Robert Ostell and Juno Lloyd.

Other early river steamers on the River Yare about this time were the *Royal Sovereign* and in 1829 there was launched the *Spring* and, the next year, the *Emperor* took the water, both having been built in Norwich, the last-named being 80 feet long and powered by an engine of 20 h.p., probably of London make.

The success of steam navigation on the Orwell and the Yare rivers, free then from the everlasting persecution from Catchment Boards and the like, must have been contagious, for in 1814, the *Stirling* was steaming between Stirling and Leith, and in Lincolnshire, William Howden, of Boston, had built in 1825 a little engine of only $2\frac{1}{4}$ h.p. to propel on the River Witham a boat 24 ft. long. It was quite successful and voyaged to Lincoln and back. A year or so later, the *Dart* was plying upon the River Trent and also operating a ferry service.

Apart from the original *L'actif*, most of these early steam vessels had lines very reminiscent of the river wherry [redacted] common on inland waters in the latter part of the last century and the early part of this. The top deck would be erected at about gunwale level, with the engine and its boiler set on the lower deck; the funnel was adequately guyed and served as a hollow mast. The wherry form of hull was very efficient and, unlike the modern cabin cruiser, little power was wasted in creating a useless wash. Thus, as time went on it was only logical for some of the later trading vessels to be made with [redacted] wherry form of hull and fitted with steam plant. So we have the steam wherry and examples were to be found on both the Orwell and the Yare; they carried such names as *Topaz*, *Annie*, *Busy*, *Primrose*, *Actif* (probably to perpetuate the old original pioneer), and *Opal*. The last-named is yet in use on the Yare.

It should, therefore, be [redacted] source of pride to the East Anglian that such occurrences took place on his local rivers and did much to develop the transport on our principal waterways.

The author has inspected several engravings showing views of some contemporary vessels; but on only one was the name *Dart* (already noticed)—discernible and this generally was unsuitable for reproduction.

Perhaps as a result of these researches and speculation, some reader may be able to add some facts to what is a most fascinating subject for historical engineering research and one in which a knowledge of early models may play [redacted] helpful part.

TWIN SISTERS

(*Continued from page* 136)

side to side. The best plan is to put strips of metal to simulate the side sections of the foundation ring, in place, and clamp these as well as the front edge.

General Notes

It is all very well forging ahead at this rate, but I must put in [redacted] word or two of warning, just in case someone tries to complete the boiler from this first general arrangement.

First of all, the top steam pipes project through the front tubeplate and the backhead, to pick up with pads to be described later, so these should not be cut yet. By all means rough such sections as foundation ring sides, which are $\frac{3}{8}$ in. $\times$ $\frac{1}{4}$ in. You may also have noticed that the main side stays in the outer wrapper appear to be short by one rod at the back end; this is intended—explanations later.

I have made no mention of all the stage setting that usually goes with brazing, such as piles of coke, bricks, acid splashes when quenching, and the rest of it. I reckon you all know the rules by now. Figures ?—Certainly, here they are :—

Total heating surface	420 sq. in.
Tube " "	270 sq. in. (10.8 sq. in. per tube)
Superheaters heating surface	100 sq. in.
Firebox heating surface	50 sq. in.

(*To be continued*)

Components for Radio Control

BY RAYMOND F. STOCK

The first part of a new series dealing with the electrical and mechanical details from the constructor's aspect

VARIOUS systems of controlling models by radio are not infrequently published in the modelling Press, but the newcomer to the subject may find it difficult to obtain information on the construction of certain common components.

The object of this article is to give constructional details of a few pieces of electro-mechanical equipment which are often specified in control systems. As a matter of interest the components to be discussed are regarded as part of an actual system (which could be copied directly for certain applications) but it should be realised that these parts may be combined in many other ways to give different results : some alternative layouts will be considered later.

System

It is assumed that any type of single-channel radio gear is available, and that the output connections from the receiver relay are closed whenever the transmitter is keyed.

Fig. 1 shows the circuit of a simple circuit selector which immediately follows the radio. The two leads on the left are connected to a battery via the relay, so that whenever a signal arrives the electromagnet *A* attracts its armature. The latter is provided with the usual pawl operating a ratchet wheel, and a single signal serves to rotate the latter and move wiper arm *B* from one contact to the next.

There are three contacts (shown black) two of which are connected to a battery ; a centre tap from the latter goes to the wiper arm via a motor *M*. Since *M* is a permanent-magnet motor it rotates in either direction according to the polarity of its power supply. By stepping the selector around its three positions one can therefore cause the motor to rotate in either direction or to remain stationary (on the third position).

If the motor *M* is geared to the rudder or steering mechanism, control in either direction is thus possible.

This idea is, of course, an old one : the amount of rudder applied depends on a time factor (i.e. the length of time the motor is permitted to run in either direction) and this prevents one having a precise control over the rudder position. However, provided reasonable way is kept on a model, its course can be controlled quite adequately without ever knowing the rudder angle, simply by observing its behaviour.

A selector as outlined above is a single-pole three-way selector. The motor *M* with its gearing is conveniently made up in a separate unit as a self-contained electric actuator.

It is desirable to cut the motor whenever the rudder reaches a predetermined maximum angle either way : this is done by including limit switches in the battery leads at *X* and *Y* (Fig. 1) which are pairs of contacts normally closed but which are opened when the actuator reaches its maximum travel either way.

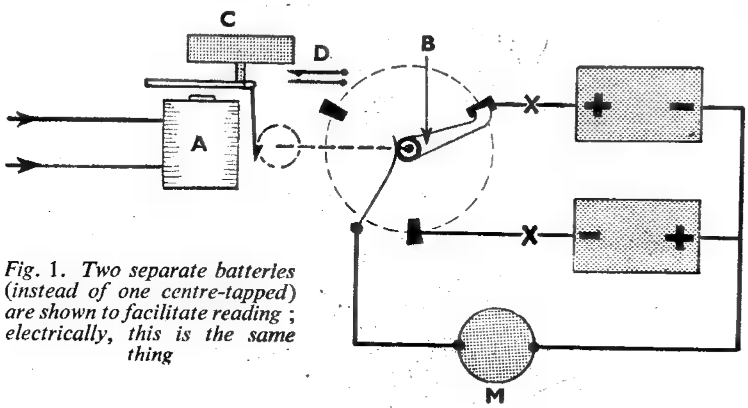


Fig. 1. Two separate batteries (instead of one centre-tapped) are shown to facilitate reading ; electrically, this is the same thing

Engine Control

Whatever the motive power of a model it is desirable to be able to control it ; this can be done by a simple attachment to the circuit selector.

The pair of contacts **D** (Fig. 1) are normally held open by the armature of the selector in its rest position. When the armature closes, the contacts begin to close, but are restrained by a simple delay device shown diagrammatically at **C** ; they do not actually touch owing to the short time for which the armature is attracted.

If, however, a long pulse is sent, contacts **D** make, and can operate a motor control selector. This long pulse will also have the effect of rotating the *steering selector* wiper arm just as a short pulse would, but its effect can be immediately cancelled by the transmission of two short signals : this restores the steering selector to its previous position while leaving the motor selector advanced by one step.

The selectors work on the return stroke of the armature, so that the relatively long pulse does not affect the steering mechanism until it ends. It can thus be effectively cancelled by the two short signals following it.

The steering selector will operate at a high speed—10 or 12 pulses a second. Since the maximum number of signals to be sent is only two, control of the steering motor may be regarded as virtually instantaneous. This disposes of the snag associated with many sequence systems which have a time lag too great for use in a fast model. In this case with a separate sequence mechanism for the motors, any number of engine control positions can be used without prejudicing the steering control.

Operator's Control

By limiting the basic sequence

to three positions, another advantage is gained. A further accusation often levelled at sequence systems is that the operator must work out mentally the correct code of signals to be sent.

If one is prepared to use an electrically-driven pulsing unit, any number of sequence positions can be controlled (as explained in "M.E." No. 2677). Many modellers, however, would prefer to cut out the complication and possible unreliability associated with such a unit, and with only three positions in the sequence described I have devised a simple manual pulsing unit that will relieve the operator of remembering the sequence.

Fig. 2 shows a simplified view of the control, which is made up as a unit to be held in the hand and connected to the transmitter by a two-core lead.

A is an arm mounted on a control knob shaft (not shown) and carries at the end a swinging link **B**. The latter is kept roughly tangential to the end of the arm by spring **C** so that as the arm **A** is rotated through a small angle peg, **D** tends to follow a true arc. It interferes, however, with the two guides **E** and **F** which cause it to pass below them when moving outwards from the centre, and above them when moving in. As shown the arm is in the central position; when moved by the control knob to left or right peg **D** follows the path shown by the dotted lines and arrows.

The peg is connected via link **B** and spring **C** with one transmitter keying lead, while the other lead is taken to **G**, **H** and **J**. These are three pillars to which are soldered a number of contact blades arranged as in Fig. 2 and these, by their asymmetrical arrangement always cause the correct number of pulses—one or two—to be sent when the arm is moved from one position to another. Arm **A** is spring loaded to its central position (equivalent to steering motor off). The control knob is therefore merely pressed to port or to starboard to initiate the correct rudder travel; releasing it permits it to return to centre and stops the steering motor.

This is not, of course, a proportional control, but it does move in a correct and logical sense and is easy to use in practice. It is only necessary to remember to move the knob to its limit each time (otherwise incorrect pulses are sent).

Even the latter limitation can be removed by using a simple clockwork pulse unit which will be described later.

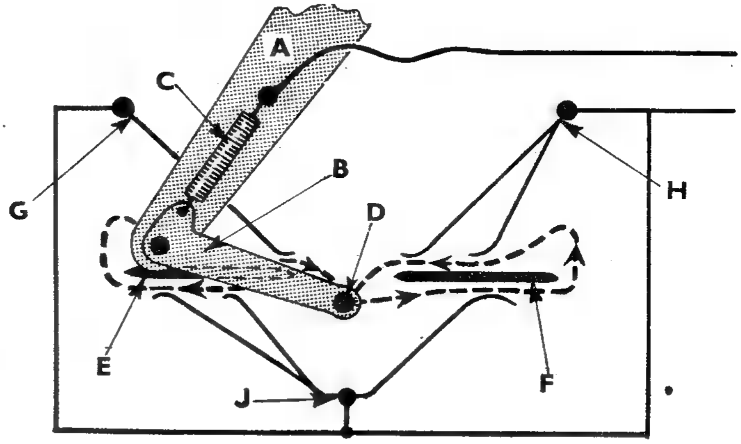


Fig. 2. Peg "D" is on the underside of link "B"

Motor Selector

This operates on the same principle as the steering selector, but the unit described has two wiper arms and four positions (two-pole, four-way) to enable it to be used for controlling a permanent-magnet propulsion motor. For other prime movers a different arrangement may be needed, as will be noted subsequently.

Fig. 3 shows the circuit associated with this component. **D** is the pair of delayed contacts shown in Fig. 1. Energising the electromagnet in pulses causes the two wiper arms to energise successively circuits **A, B, X** and **Y** from the main propulsion battery **P.** By incorporating resistors in **ABXY** and reversing their connections the main motor can be controlled.

Circuits

The individual components and their circuits are simple and have been shown each with its own battery. In practice a common battery of secondary cells would be used for all purposes in an electrically propelled model, and probably for an i.c. or steam model a single dry battery would be used.

Fig. 4 shows the connections between units when they are combined on one panel to form a complete control mechanism (as is most convenient).

Plug connection **A** is to receiver relay, **B** is to battery (1 = +, 2 = —, 3 = centre tap), **C** is to propulsion motor. **D** are the delayed contacts, **E** the steering selector. **M** is the steering motor and **X** the two limit switches. **G** is the motor selector, and its four positions 1, 2, 3, 4 are wired to give Full Astern, Stop, Full Ahead and Slow Ahead respectively.

Construction : Steering Selector

To conserve space detailed drawings of the various parts have not been made : no dimensions are critical and the sizes may be taken sufficiently well from the assembly shown in Fig. 5.

Three views of the unit are shown (top left) together with some sketches of the less obvious parts on the right.

The best place to commence is with the electromagnet.

The core is shown dimensioned (top right) and is turned from soft iron (if available) or mild-steel rod. The keel end is turned down to be a push fit into the hole in the yoke **A** where it is retained by a 4 B.A. steel screw.

The yoke is cut and bent from similar material and the two mounting lugs are drilled and tapped 6 B.A.

The two lugs at the end of the yoke are drilled and tapped 8 B.A. to take the pivots for the armature; the pivots **B** consist of two brass 8 B.A. screws with the thread turned off the end $\frac{1}{8}$ in. This plain portion projects inwards beyond the lugs, each side, to form a pivot upon which the armature is mounted.

A piece of soft-iron strip (as used for the yoke) is filed to shape for the armature **C** and a cut-out made at one end to receive the end of the pawl **D**, which is retained by a steel pin. The other end of the armature is drilled with a cross hole to take the ends of the pivot screws.

Riveted to the armature is its extension **E**, a strip of aluminium bent and cut to the shape shown. One end is waisted for attachment

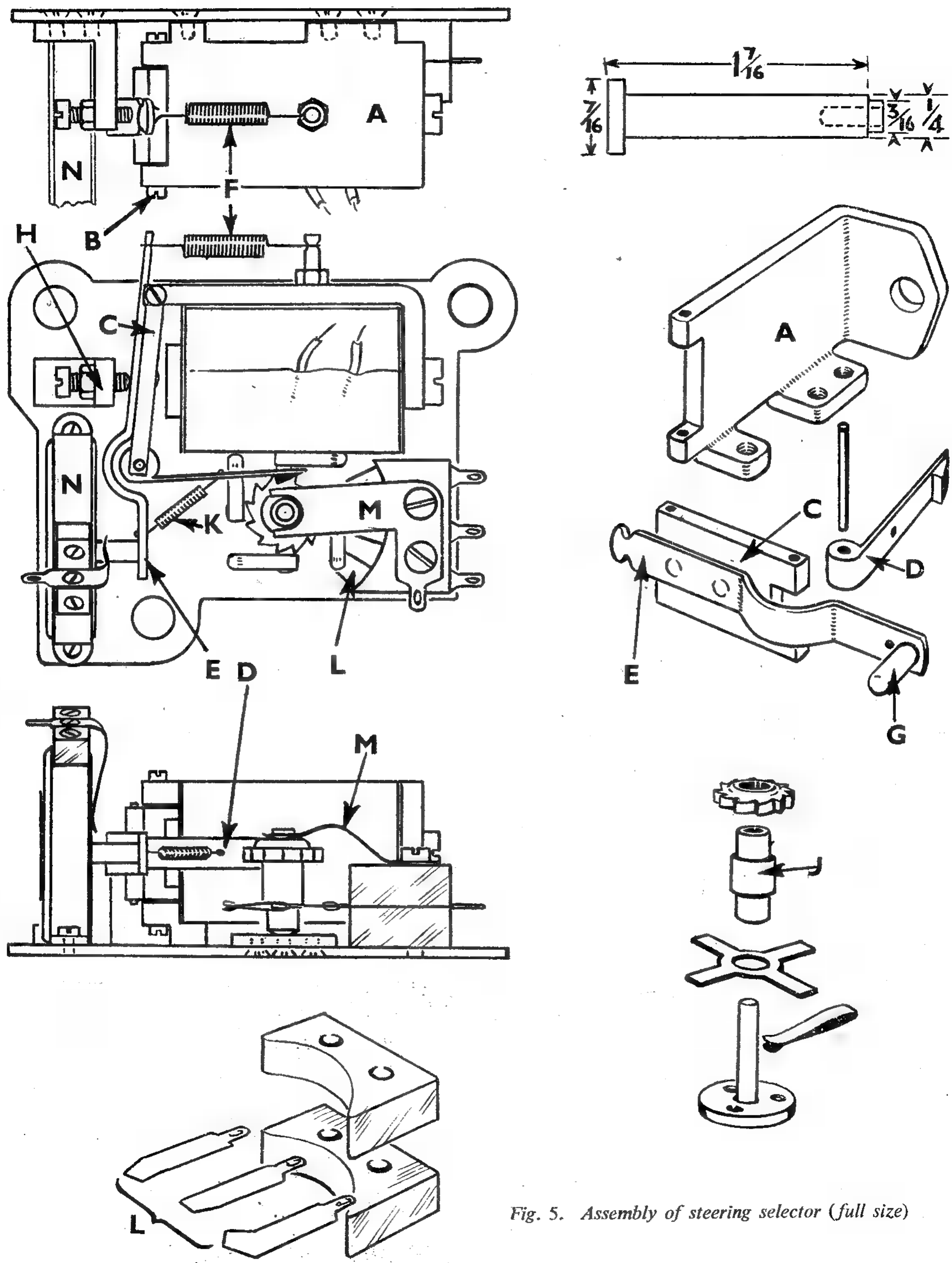


Fig. 5. Assembly of steering selector (full size)

of the return spring F while the other carries a short rod of insulating material G. A piece of old plastic knitting needle will do here, and is fitted by a 10 B.A. screw passing through E into a tapped hole in G.

The return spring is fixed at its other end to a small pillar screwed into the yoke.

The pawl is fabricated from a strip of brass having a steel tooth at one end, and a brass bush at the other, both fixed by silver-soldering (or even soft-soldering will do if sufficient area is provided at the joint).

One of the two rivets uniting the armature and its extension is allowed to project on one side by a few thou. This butts against the pole piece, and prevents an iron-to-iron contact between pole and armature ; this refinement avoids the armature "sticking" and helps speed up operation.

The core is insulated by a turn or two of paper glued over its length and end cheeks are glued over this ; they may be cut from thin card or paxolin. The winding is of 30-g. enamelled wire wound out to the full diameter of the bobbin—$\frac{13}{16}$ in. The starting end is passed through one end cheek and after winding it may be brought up to the periphery where both ends should be provided with thicker connecting leads. The winding is covered with a few turns of draughting tape. Depending on how tightly it is wound the completed electromagnet should have a resistance of about 7 ohms.

The electromagnet is screwed to a 16-g. aluminium base shaped as shown in the plan view. Immediately behind the armature is the back-stop H, an L-shaped brass bracket provided with a lock-nutted adjusting screw by which the travel of the armature may be controlled.

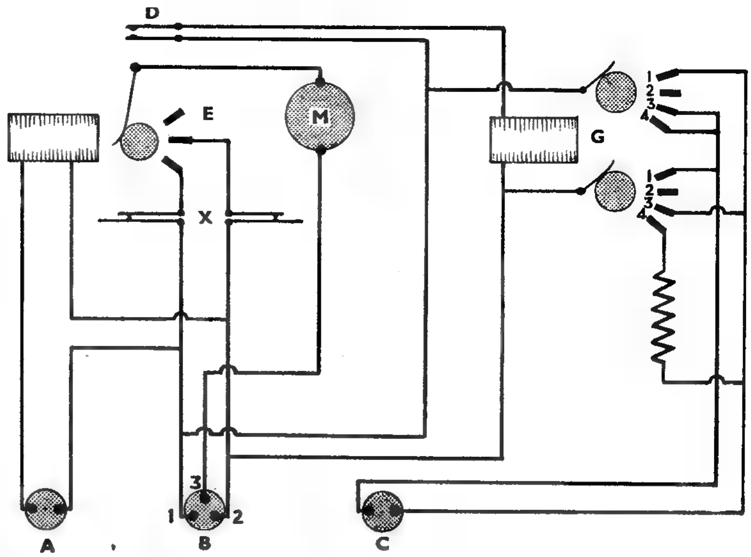


Fig. 4

The moving assembly should now be made. This is shown exploded (lower right) and its construction will be obvious. The toothed wheel can be filed from brass or steel and is sweated to the brass bush J. A cruciform member of 1/32 in. brass sheet is soldered against the lower shoulder, and to each of the arms is soldered a folded strip of springy copper foil, formed as shown. The bush is drilled out $\frac{1}{8}$ in. and the whole assembly rotates upon a vertical shaft (of steel) flanged at the base where it is drilled and tapped 8 B.A. at three points to take the holding down screws.

A very light spring K is stretched between the pawl and the armature extension and serves to keep the pawl in contact with the toothed wheel. The three static contacts L are cut from thin brass or hard copper sheet and sandwiched between two blocks of perspex, the centre lines of the contact areas being 30 deg. apart. The sandwich is held together and to the aluminium base by two 6 B.A. screws ; under their heads is trapped an L-shaped strip of springy brass M bent as shown to bear on the top surface of the ratchet wheel. The end of the strip is forked to clear the projecting bush.

With all these parts assembled the selector may be adjusted. First the back-stop should be screwed up until the movement of the pawl is just sufficient to span one tooth pitch. The return spring F is then tightened until it has sufficient power to rotate the wiper arms against contact friction. Each wiper arm should pass across both faces of the static contacts with a smooth even action and the edges of the contacts should be filed to a blunt knife-edge to facilitate this.

Spring M has the double function of making a good electrical contact with the moving part, and of applying a braking force to the moving assembly. By adjusting its tension against that of return spring F it should be possible to find a point where the wiper arms move accurately from one contact to the next at every pulse. Initially, the cruciform member should only be pressed on to the bush as it will probably be necessary to rotate it relative to the wheel in the process of adjustment.

(*To be continued*)

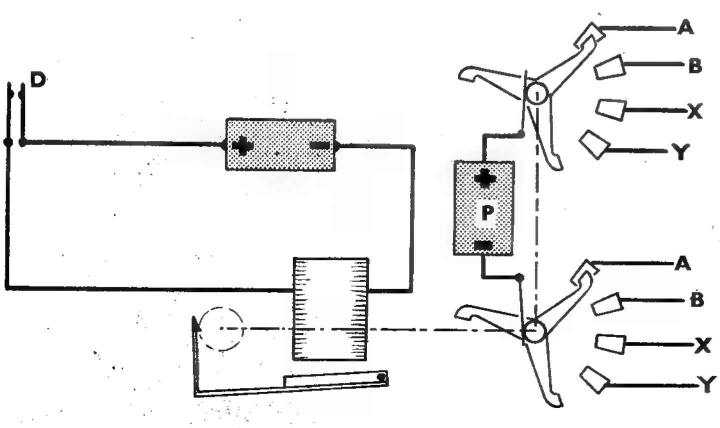


Fig. 3

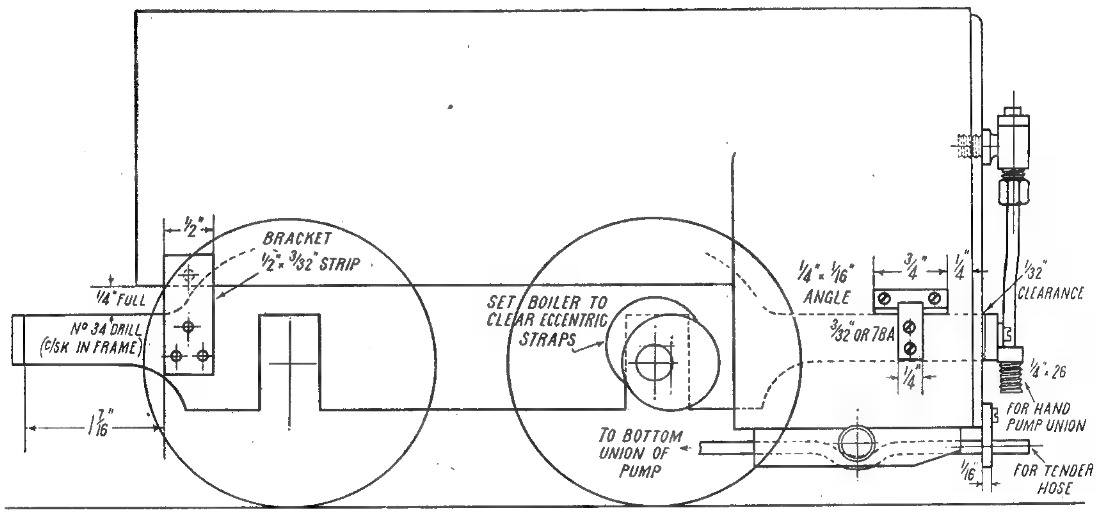
L.B.S.C.'s "Britannia" in 3½ in. Gauge

BOILER FITTINGS

THE boiler fittings that I am specifying for the "ancient and honourable" would just about send her original designer into the seventh heaven of delight, and Inspector Meticulous into the nuthouse—or the "local"! The fittings on not-so-big sister were conspicuous by their absence; the only pictures that I have, give no information of what the old girl carried when she was in commission. Mr. Holcroft sent me a photo-reproduction of the rear end, taken from the back of the right-hand driving wheel (made it up as a greeting card, hoping I'd always be sure of a good ration of "Canterbury Lamb"!) and this shows two straight-nosed bib-cocks screwed into the side of the boiler barrel. How the fireman managed to get at them for testing the water level, history doesn't say—but I'll bet the fireman said a mouthful! Anyway, we are building the engine to do the job, not as a museum piece to spend its life in a glass case, and having put a proper boiler on it, the fittings must be made suitable.

Check Valves or Clacks

Two clacks will be needed, one to take the feed from the eccentric-driven pump, and one for the feed from the emergency hand-pump in the tender. Did I hear somebody say, how about an injector? Well, if you can find some place to put it—for example, below the frame, behind the left-hand driving wheel—go right ahead and fit one, if you so desire. The steam valve can be similar to that specified for *Petrolea*, and the delivery clack can be screwed into the boiler shell, above the injector; but too many blobs and gadgets will spoil the effect. A drawing of the clacks is reproduced, and I've detailed out the making of clacks so many times, that repetition is needless; all necessary dimensions are given. Both of them can be screwed direct into tapped holes in the backhead, as near on the centre-line as possible; see views showing backhead fittings, and the boiler erected. Leave out the pipes for now.



How to erect the boiler

Steam Gauge

A commercial steam pressure gauge, ¾ in. diameter, reading to 120 lb. will be needed. These gauges *can* be home-made; in fact, I have given instructions on how to make them, but it is a fiddling job, and you need a full-sized gauge to calibrate them, anyway. I use commercial gauges myself, time being so precious now, and have tried both Reeves's and Kennion's, both proving O.K. in service. The reproduced drawing shows how the steam gauge is fitted to the boiler, and the backhead illustration shows where. The syphon is merely an inverted swan-neck of ⅛-in. copper tube, the union nut of the gauge being fitted to one end of it, plus a cone of the usual pattern, to fit the screwed nipple of the gauge. Some nipples are flat-ended instead of coned; and if you find yours to be thus, just silver-solder a wee flat collar on the end of the syphon pipe, similar to those I specify for the steam end of an injector.

The flange is simply a 3/16-in. slice of ⅜-in. rod (brass will do, there is no movement). Leave a ⅛-in. pip, 3/32 in. long, when parting off the slice. Reverse in chuck, and drill the pip with a 1/16-in. drill three-parts through the flange. Drill a No. 32 hole in the edge of the flange, breaking into the blind hole as shown. Drill three No. 51 holes for screws, silver-solder the swan-neck into the hole in the edge of the flange, drill a ⅛-in. or No. 30 hole in the backhead to accommodate the pip, and secure flange to backhead with three 1/16-in. or 10-B.A. brass screws. Put a 1/32-in. Hallite or similar jointing washer or gasket between flange and backhead.

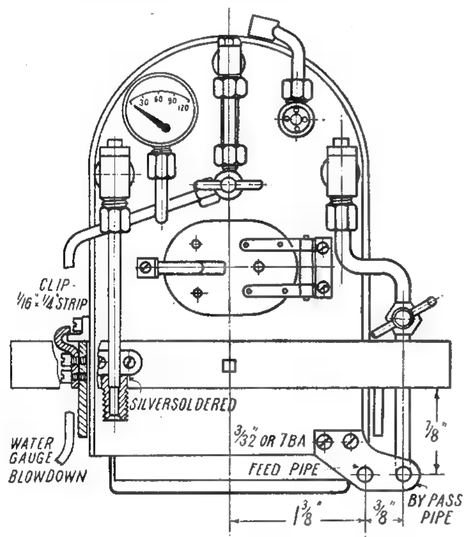
Steam Connection to Blower Valve

As there is no turret on this engine, steam for the blower must be taken from a separate fitting which can be located alongside the spring case of the safety-valve. Chuck a bit of $\frac{1}{4}$-in. brass rod in the three-jaw, face the end, centre, and drill down to $\frac{5}{16}$ in. depth with 3/32-in. or No. 41 drill. Turn down 5/32 in. of the outside to $\frac{3}{16}$ in. diameter, screw $\frac{3}{16}$ in. × 40, and part off at 7/32 in. from the shoulder. Drill a No. 32 hole into the side of the head, and silver-solder 1 in. or so of $\frac{1}{8}$-in. copper tube into it. Get the exact length by measuring from the side of the spring casing, to the union on the blower valve, with a bit of lead fuse wire, or soft copper wire. The outer end of the pipe is furnished with a union nut and cone, as shown.

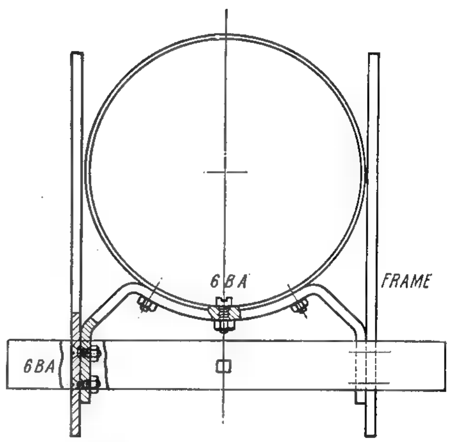
Drill a 5/32-in. hole in the edge of the wrapper sheet, about $\frac{1}{2}$ in. from the anchor fork of the safety-valve ; this will go through the backhead flange, and give plenty of hold for the thread. Tap $\frac{3}{16}$ in. × 40, and screw in the fitting, with a smear of plumbers' jointing on the thread. You'll have to temporarily remove the spring casing, to turn the fitting, on account of the projecting pipe. When home tightly, bend the pipe so that the cone will enter the union fitting on the blower valve, and tighten up the union nut.

Water Gauge

This is another backhead adornment that I have described goodness knows how many times. The upper part is made in a similar manner to a check valve or clack, but is drilled right through with a 5/32-in. drill. If the glass is a tight fit in a 5/32-in. hole, use a larger drill, say 20 or even 19. The stem for connecting to the boiler, is turned from $\frac{3}{8}$-in. rod and silver-soldered in. The bottom part is also turned from $\frac{3}{8}$-in. round rod. Chuck in three-jaw with $1\frac{1}{4}$ in. projecting ; face, centre, drill to about $\frac{5}{8}$ in. depth with No. 48 drill, open out and bottom to 11/32 in. depth with $\frac{1}{8}$-in. drill and D-bit, and tap 5/32 in. × 32, which gives a quicker-opening valve than a 40 thread screw. Turn down $\frac{3}{4}$ in. of the outside, to $\frac{5}{16}$ in. diameter, and part off at 1 1/32 in. from the end. Reverse in chuck, centre, drill down to $\frac{9}{16}$ in. depth with $\frac{1}{8}$-in. drill, turn down 5/32 in. of the outside, to $\frac{1}{4}$ in. diameter, and screw $\frac{1}{4}$ in. × 40. At $\frac{5}{16}$ in. from the shoulder, drill a No. 14 hole into the passageway, and fit a $\frac{1}{4}$-in. × 40 nipple into it, counterbored 5/32 in. full, to take the lower end of the glass. At 9/32 in. from the other end, at approximately the angle shown in the view of the backhead, drill a 5/32-in. hole into the screw socket (mind the valve seating !) and fit a $\frac{3}{16}$-in. × 40 union nipple in it, for the blowdown pipe union. Silver-solder both joints, and make a screwed valve pin as shown, from 5/32-in. rustless steel or bronze. You won't need telling how to make gland nuts (or shouldn't by this time, anyway) and the assembly and erection are clearly shown in the illustrations. For beginners' special benefit I'll repeat—gauge glasses must *not* be tight in the fittings ; if expansion is not allowed for, they speedily break. The glass must be an easy fit in the sockets and gland nuts, and the top and bottom parts of the gauge must line up exactly ; so test with the shank end of a drill, a shade bigger in diameter than the glass, after the fittings have been screwed home in the backhead. If the drill doesn't drop by its own weight to the bottom of the lower socket, adjust the fittings until it does, otherwise you've had it. The holes in the backhead are drilled at $1\frac{1}{2}$ in. centres.



Backhead fittings



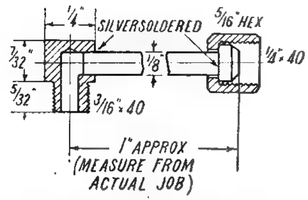
How front end of boiler barrel is supported

Note—the general arrangement drawing of the complete engine, showed a water gauge with a plug cock at the bottom. This was intentional, and can be fitted as an alternative, if you don't mind hot water splashing down from an open cock. If a drain-pipe were fitted to it, it would foul the firehole door. Another alternative would be to make the bottom fitting just the same as the top one, but fit it upside down ; and in place of the plug, fit a union, and $\frac{1}{8}$-in. pipe, putting a plug cock in the pipe, anywhere you like as long as it is clear of the firehole and other fittings.

Firehole Door

Our approved advertisers sell castings for the swing-type firehole doors, and they have the hinges cast on. Simply clean up with a file, fit the catch, drill for hinge pin, and if the baffle plate is not cast on, fit one made from 16- or 18-gauge steel. The hinge lug is shown in the view of the backhead and needs no description ; it can be filed up from

a suitable scrap of brass. The catch spring is just a bit of thin springy brass or steel, bent at right-angles, and attached to the backhead with a screw. The door can also be built

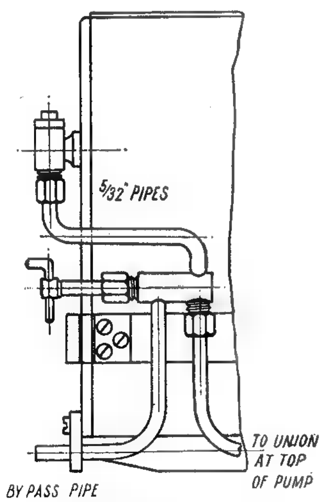


Blower connection

up from steel plate, as fully described in the instructions for *Tich.*

How to Erect the Boiler

First of all, bend up a bracket from ½-in. × 3/32-in. strip metal, to the shape shown in the front-end view of the boiler. The ends of this should fit nicely between the frames, and the curved part should be the same radius as the boiler. The bracket is attached to the boiler shell by three 6-B.A. screws as shown, nutted outside; set it about ¼ in. from the front end. Next, put the boiler in place on the frames, the ends of the bracket going between



By-pass and feed pipe arrangement

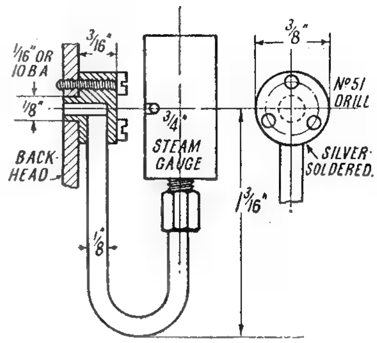
them. Adjust boiler so that the bottom of it is ¼ in. above the frames at the front end, and 1/32 in. away from the drag beam. Set the boiler level, so that both ends are the same height from the rails. Run a scriber along the top of the frame at each side of the firebox wrapper, and make a scratch about 1¼ in. long on the copper. Remove boiler, and at ¼ in. from the back, at each side, screw a ¾-in. length of 1/16-in. × ¼-in. angle brass, or a bit of sheet brass bent to an angle. The bottom must be set exactly level with the marks made by the scriber. Sweat over the whole lot, angles and screwheads, to ensure that there will be no chance of leakage.

Replace boiler, and set dead level, as before. At the front end, at each side, drill three No. 34 holes right through frame and bracket; this can be done between the wheel spokes. Countersink the holes, and put 6-B.A. screws in, nutting them on the inside, as shown in the front view. To hold the back end down, yet allow for expansion, make two clips (like question marks) from 1/16-in. × ¼-in. steel strip, attaching them to the frame with two screws in each, the upper part of the clips hooking over the angles, as shown in the section at the left-hand end of the drag beam in the backhead view. The brackets being free to slide on the frames, and the clearance between backhead and drag beam, allows the boiler free movement for any expansion and contraction which may take place when the engine is in steam.

Feed Pipes

Now we have to practise the plumbers' art. First job is the feed pipe for the emergency hand pump which will be fitted in the tender. This is a piece of ⅛-in. copper tube 1¾ in. long. One end carries a ¼-in. × 40 union nut and cone, and I don't have to tell you any more about how to do that simple job! The other end carries a ¼-in. × 26 union nipple, the plain end of which is silver-soldered to the pipe; and at the same heat, silver-solder an oval of 16-gauge sheet brass or copper to the pipe, as shown. This should be about ¾ in. long, and ½ in. wide. After cleaning up, drill a No. 40 hole in the flange at each side of the pipe. Attach the union to the left-hand clack, and fix the flange to the drag beam by a couple of 3/32-in. or 7-B.A. screws, as shown in the illustrations. The vertical union will give more freedom for the movement of the connecting pipe on this particular job and is just as easy to couple up, as one of the usual horizontal pattern.

Next, cut out the comical-shaped bracket (it looks like a bed sock!) shown under the drag beam at the right-hand side, in the backhead view. The exact shape doesn't matter, as long as the holes are in the position shown (use No. 21 drill) and the two screws holding the bracket are tapped into the foundation ring of the boiler. Measure from the bottom union of the feed pump, to the bracket, with a bit of soft wire, and cut a piece of 5/32-in. copper tube to same length plus ½ in.

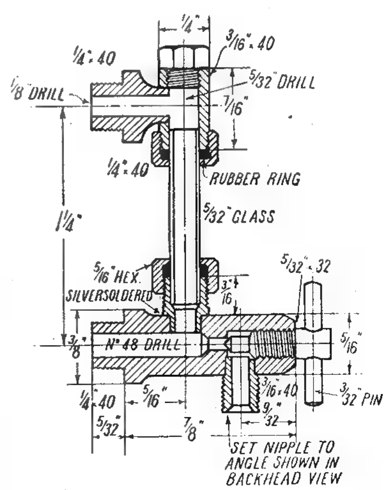


Steam gauge fitting

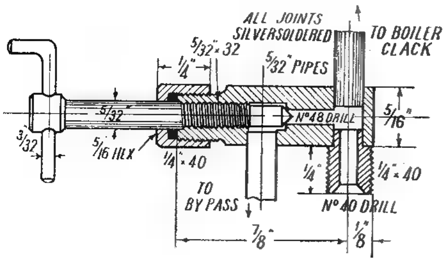
for the hose connection to tender. Attach by a union to the pump, letting the pipe project through the bracket as shown; you'll have to make a little kink in it, as shown by the dotted lines, to clear the dumping pin.

Bypass Pipe and Valve

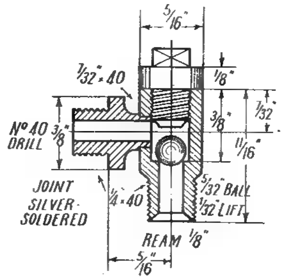
To make the valve, part off a 1-in. length of 5/16-in. round brass rod, and at ⅛ in. from the end, drill a cross hole, using No. 23 drill. Chuck in three-jaw, with the undrilled end outward; centre, drill No. 48 right into the cross hole, open out and bottom with ⅛-in. drill and D-bit to 9/16 in. depth, and tap 5/32 in. × 32. Turn down ¼ in.



Section af water gauge



Section of bypass valve



Section of clack or check valve

of the outside to $\frac{1}{4}$ in. diameter, and screw $\frac{1}{4}$ in. × 40. At $\frac{7}{16}$ in. from the screwed end, and in line with the cross hole, drill another No. 23 hole, breaking into the tapped hole just against the valve-pin seating; see section. The pin is made from rustless steel or bronze as shown, the "brake handle" being optional; you can fit a handwheel if preferred. The overall length of the pin should be $1\frac{3}{8}$ in. The gland nut needs no describing.

Now there is a spot of measuring to do. Hold the valve in the position shown in the illustrations, down by the right-hand side of the firebox. Measure from the hole nearest the gland, to the bracket underneath, allowing for an easy bend, and $\frac{1}{8}$ in. projection for the tender hose, or "feed bag." Measure from the upper part of the cross hole, to the union on the right-hand clack, also allowing for easy bends. I use a bit of soft wire for jobs like these; when straightened out, it gives the exact length of pipe needed, and ye dinna waste a mickle, vot you tink, eh? Cut the pipes to lengths indicated, also fit a $\frac{1}{4}$-in. × 40 nipple in the lower end of the cross hole, and a $\frac{1}{4}$-in. × 40 union nut and cone on the upper pipe. Silver-solder the lot at one heat, then pickle, wash off, clean up, and erect as shown, the union nut being attached to the clack, and the end of the bypass pipe poked through the outer hole in the bottom bracket.

Now comes the final bit of measuring; run your bit of soft wire from the union on the bypass valve, down the side of the ashpan, and then along inside the frame, continuing up to the top union on the valve box of the feed pump. Make the bends as easy as possible, as before; uninitiated folk would be astonished at the difference that easy bends make to the efficiency of weeny pumps. Cut your pipe to the length indicated by the wire; put a union nut and silver-soldered cone on each end, attaching one to the pump union and the other to the union on the valve, being careful to bend the pipe without kinking it. I just anneal the pipe, and make any necessary bends with my fingers only. All the water delivered by the pump passes through this pipe, and if the bypass valve is open, it takes the line of least resistance and returns through the bypass pipe to the tender; but if the valve is closed, it goes straight across the end of the bypass valve, continues through the upper pipe, bumps up the clack, and enters the boiler. That completes the job in the basement; next, we have to take our tools upstairs and do a bit of plumbing "on the roof."

FOR THE BOOKSHELF

Locomotive Cavalcade, 1920 to 1951, by H. C. Casserley. (Published by the author, at "Ravensbourne," Berkhamsted, Herts.) 216 pages, 3 coloured plates, 300 illustrations. Price 20s., including postage.

This book is a most interesting and telling record of British locomotive practice during a vital 30-year period of its history. The text is written in an easy, readable style and is arranged in 31 extended paragraphs, each of which is devoted to the locomotive happenings of one year, progressively from 1920 to 1951. Throughout, a very careful record is kept of the last examples of locomotive types and classes withdrawn from service, and of new ones that were put to work, the whole making up into, literally, a most striking cavalcade which passes steadily before the reader.

This effect is strengthened by the astonishing collection of illustrations, more than 300 of them, all from Mr. Casserley's own camera. As a "one-man show" of this nature, it can surely have no equal; all the original photographs must, at least, be good, but the majority are really excellent. There are three plates in colour; one, the frontispiece, is a collection of eight small reproductions of coloured photographs, the colouring of which is pleasingly satisfactory. The second is a full-page plate of a Wainwright "D" class 4-4-0 on a train, all painted in the Southern Railway livery, and the general effect leaves little to be desired. The third, showing a Highland "Small Ben" painted in L.M.S. red livery, does not quite reach the quality of the others, from the purely artistic point of view.

The other illustrations are all halftone reproductions of photographs, the range, quality and interest of which are very striking. Selection and arrangement have obviously received most careful consideration, and each has been given a thoroughly appropriate caption.

The production of this book must have involved considerable research, industry and financial outlay, and we feel that it deserves a rich reward, not only because the enterprise of its author extends to his being his own publisher, but also because the book itself admirably fulfils its purpose and does much to restore the rather flagging prestige of modern railway literature.

Facts and Figures about British Railways.

This is the title of a useful and revealing little handbook of 32 pages recently issued by the Railway Executive. In brief notes and much tabulated matter, a surprising amount of information is given, covering every department of British Railways organisation. We understand that supplies of this booklet are limited, and applications from the public should be made to The Railway Executive, Public Relations Department, 222, Marylebone Road, London, N.W.1, or to the Public Relations and Publicity Officer of any of the six Regions.

CUTTING CLOCK WHEELS ON A SMALL LATHE

By J. C. Stevens

THE following description of some wheel-cutting accessories made for use with a small pre-war lathe will, it is hoped, be of interest to readers.

A "Portass" $2\frac{1}{2}$-in. lathe, mounted on a board and driven by a 1/20 h.p. motor, was the only machine tool possessed by the writer; however, by dint of much patience and enthusiasm the parts were eventually made and some perfectly satisfactory clock-wheels produced with them.

First, it was decided to make a fly-cutter and frame, to be used clamped on the cross-slide and, operating on the wheel blank fastened to a wooden block on the lathe faceplate. This fly-cutter is driven from the motor which drives the lathe itself—the motor (being a "double-ended" one) providing a second driving pulley roughly in the centre and to the rear of the lathe bed—jockey pulleys and a belt tension spring carrying the driving cord around the "corner."

It was thought that should the cutter work satisfactorily, some way of dividing the wheel blank into an equal number of spaces could be evolved later. As it happened, the cutter worked admirably and left an excellent finish, provided care was taken to fashion it—as will be described later.

A dividing plate was afterwards copied mechanically from a "master" (very kindly loaned by a friend), and this, in conjunction with a simple indexing device, made the production of small toothed wheels quite a simple matter.

It is now proposed to give a description of the various accessories under their respective titles. (Owners of similar size lathes by other manufacturers could easily modify one or two key dimensions to suit.)

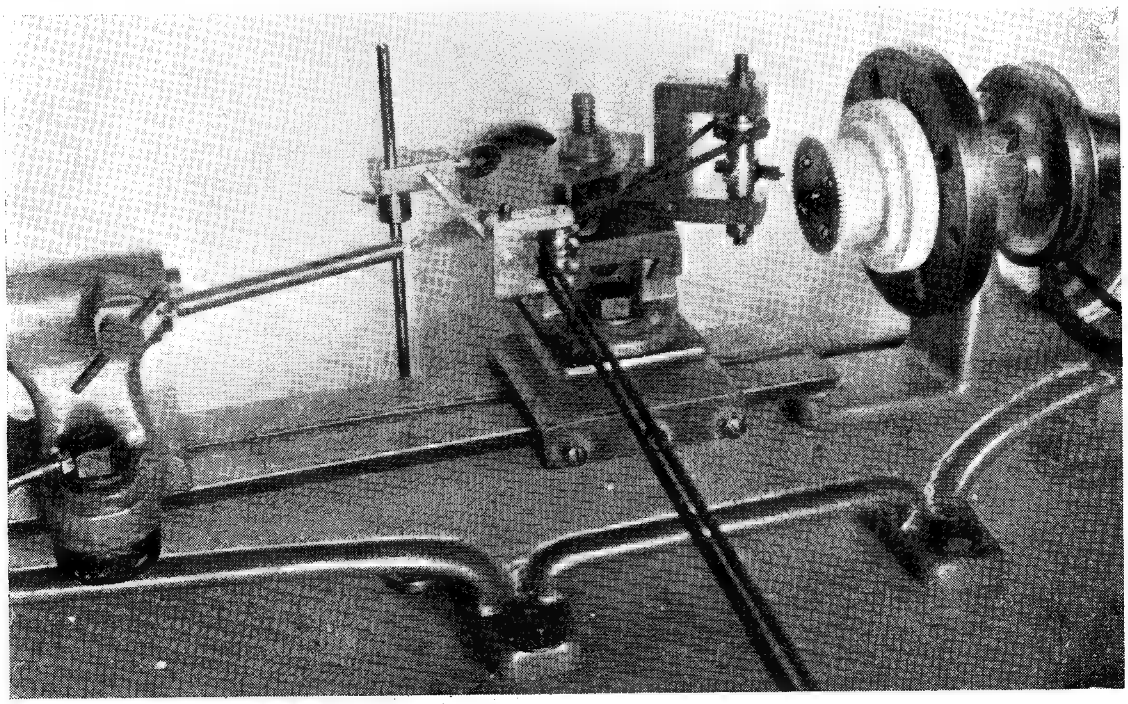
Fly-Cutter Frame. (Fig. 1)

This was carefully marked out on a piece of scrap brass 2 in. wide and $\frac{3}{8}$ in. thick, sawn and filed to shape, and the two holes drilled and tapped $\frac{3}{16}$ in. $\times$ 40 where shown to take the coned centre bearings.

Care should be taken to ensure that these tapped holes are drilled squarely to the frame, and that the top and bottom surfaces of the extension portion (by means of which the completed tool is clamped to cross-slide of lathe) are true.

The writer took some trouble to bevel the outer edges of the frame for the sake of a pleasing appearance, but the degree of exterior finish is obviously a matter of individual taste.

The coned bearings were made from $\frac{3}{16}$ in. silver-steel, turned to approximately 60 deg. angle on points, and finished with a Swiss file while running in lathe. They



Rear view of set-up

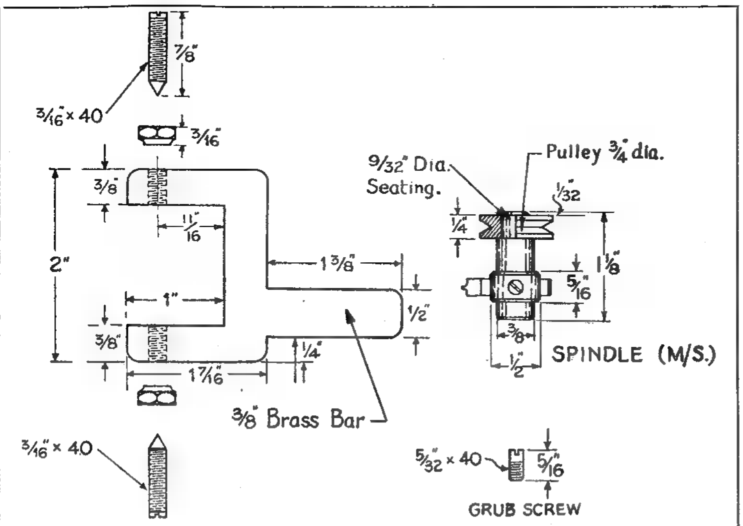


Fig. 1. The cutter frame

were then carefully screwed $\frac{3}{16}$ in. × 40 a close fit in frame, removed from lathe, and a small screw-driver slot made in opposite ends.

The cones were hardened and tempered to a pale straw, and by quenching them vertically no distortion was apparent. They were now held in chuck by means of a split brass nut (to avoid damaging the threads) and a small Arkansas stone discreetly applied to the revolving points, which produced an excellent finish—this operation must not be overdone.

The lock-nuts were turned from a scrap of $\frac{3}{8}$ in. hexagonal brass to the shape shown, and hardly require description.

The spindle is of mild-steel $1\frac{1}{8}$ in. long, faced and deeply centred at each end with a $\frac{1}{16}$-in. centre drill ($\frac{1}{16}$ in. dia. of pilot), mounted between centres and driven by a small carrier. Each end of spindle was finished in turn by reversing position between centres.

Before attempting to drill the $\frac{3}{16}$ in. transverse hole to take the fly-cutter itself, the spindle was assembled in the frame and carefully adjusted to be centrally disposed—i.e., an equal amount of clearance from end of spindle to inside surface of frame on either side.

The tool was now clamped on cross-slide, and with lathe centre in position the spindle brought into light contact with it, the spindle rotated with the fingers and a light scratch made around its circumference.

The spindle was replaced between lathe centres and two marks made at 180 deg. apart to intersect the scribed ring. These intersections were centre-punched and the spindle drilled through from either side, starting with a 3/32-in. drill to allow of possible error adjustment before drilling to finished size.

The grub-screw was made from 5/32-in. silver-steel, screwed 5/32 in. × 40, provided with slot, hardened to straw colour and polished.

The brass driving pulley was turned to size in chuck, grooved at 40 deg. angle for the leather (boot lace) belt, and using a tiny boring tool, bored so that it would *not* quite go on its seating. It was then carefully forced into position in the vice, protecting both pulley and spindle with lead clams.

For parts that should not require dismantling, the force fit method is highly satisfactory. It is advisable to ensure that the seating is nicely polished, the entering end slightly tapered and provided with a spot of oil before forcing the pulley home, otherwise there is danger of tearing the brass and producing a loose fit.

Drilling Spindle (Fig. 2)

This accessory, devised almost entirely from scrap material, was used primarily for drilling the rings of holes in the dividing plate, but was subsequently found useful for milling out the spaces in wheels to form the arms or " crossings." For the latter purpose a suitable dental burr was substituted for the drill.

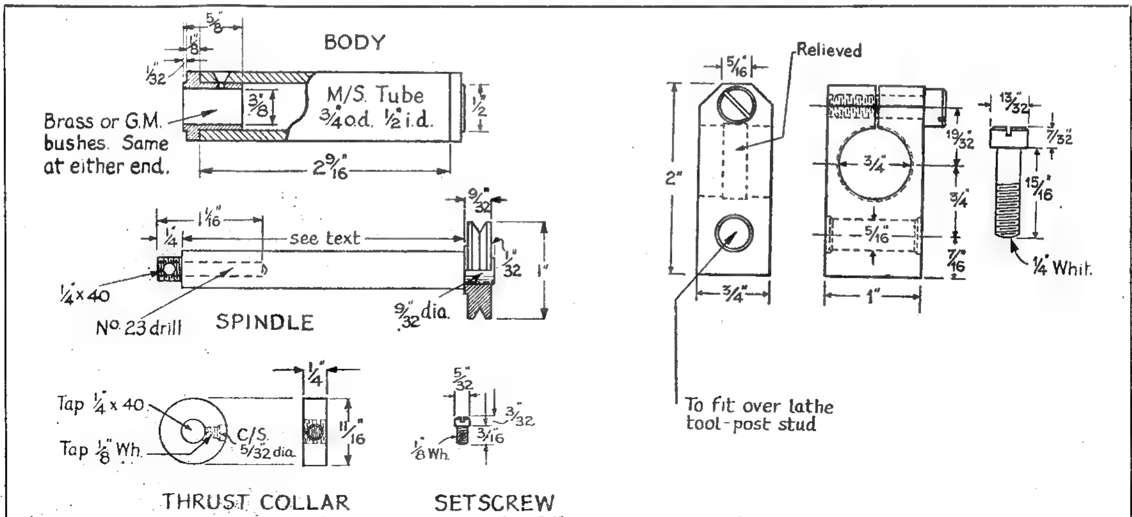


Fig. 2. The drilling spindle and clamp

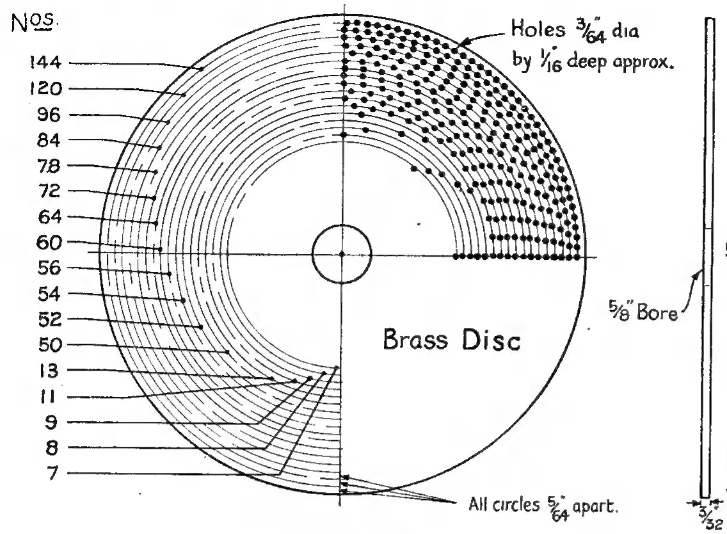


Fig. 3. The dividing plate

A piece of heavy steel tube ¾ in. outside diameter and ½ in. inside diameter, was faced up each end to measure 2 9/16 in. in length and provided with two hard brass bushes, bored and reamed ⅜ in. diameter, a drive fit in the tube.

Ground mild-steel rod ⅜ in. diameter served as a ready-made spindle, a suitable length being truly mounted in the four-jaw chuck (protected with a piece of thin card) and the ends faced off square.

An improvised steady was employed to ensure that the rod *did* run truly during the next drilling operation; this being merely a scrap of 1 in. × ⅛ in. brass strip previously bored a close running fit on rod and clamped under the tool-holder on slide-rest.

The extreme end of spindle was supported by this bearing and the rod cautiously drilled, using the tail-stock chuck. A 5/32 in. diameter centre drill was purchased and a No. 23 drill finished the hole a close fit for this item.

At the same setting, the nose of the spindle was turned down to ¼ in. diameter for ¼ in. length and threaded ¼ in. × 40.

The exact length of the pulley seating is best found by direct measurement, to give just a small amount of end clearance when the spindle is assembled. If the rod is threaded through the bushed tube and the front shoulder of spindle aligned against thrust surface of bearing, a small mark can easily be made at opposite end of spindle to indicate length of seating. The rod is now gripped in chuck and set to run truly and the end turned down to 9/32 in. diameter to this mark.

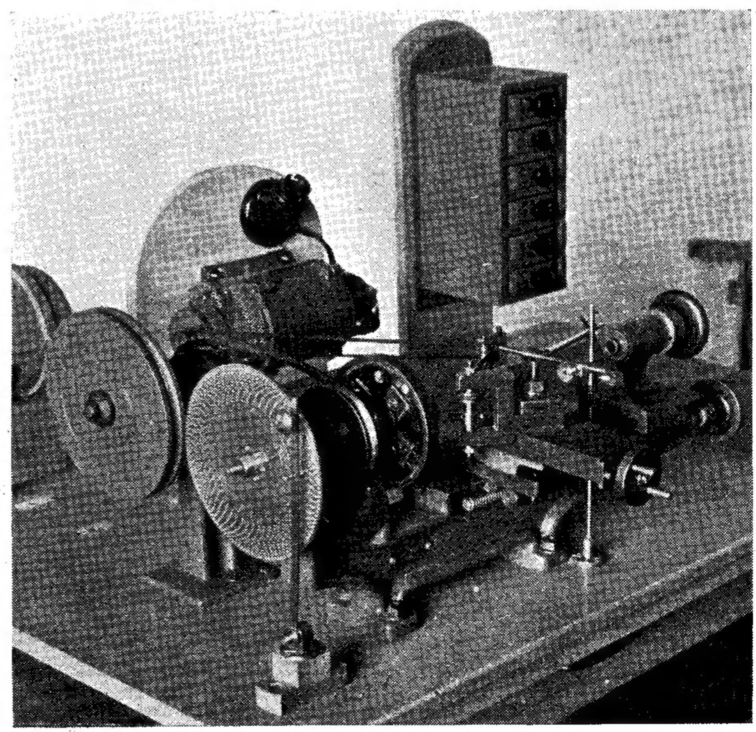
A brass pulley somewhat larger than that used on the fly-cutter spindle was made and pressed on rear end of shaft.

The front end is furnished with a mild-steel thrust collar 11/16 in. in diameter as shown in drawing, and screwed home finger-tight against the shoulder. The collar is now carefully cross-drilled with ⅛ in. × 40 tapping drill to run into the No. 23 hole in spindle, tapped right through and the collar unscrewed from nose.

A ⅛ in. set-screw with a shallow 5/32 in. diameter head, hardened and tempered, is required to grip the drill, and the tapped hole in collar is opened out 5/32 in. diameter for a short distance to suit. Two countersunk oil-holes are drilled as shown, to provide means for lubrication but, in addition, the tube was packed with grease on assembly.

It has been found necessary to plug these oil holes with cotton-wool, when using the tool, to prevent the entry of stray chips of metal; it might, therefore, be better to provide a small tapped hole clear of either bush, fit a knurled screw, and give an occasional flooding with oil.

The mild-steel clamp was cut from 1 in. × ¾ in. material and drilled 5/16 in. where shown, to fit stud on cross-slide. This hole is counter-bored ⅜ in. for a short distance either end to ensure its



General view, showing accessories set up for wheel-cutting

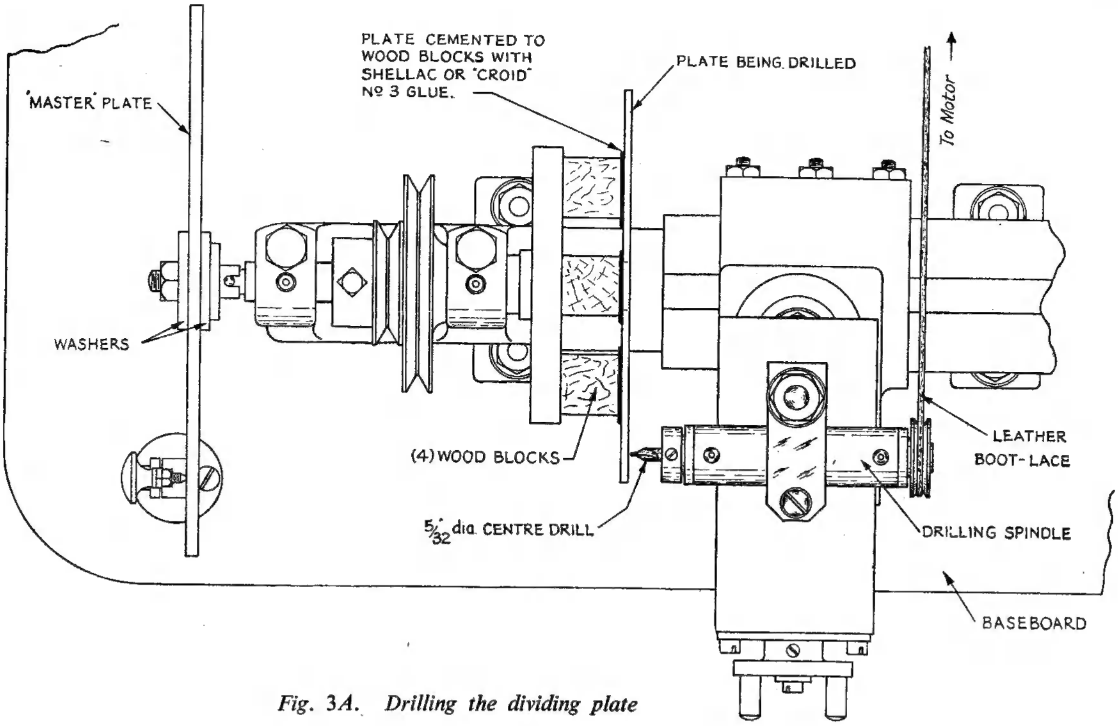


Fig. 3A. Drilling the dividing plate

bedding down satisfactorily when so clamped.

It was now mounted on the stud, adjusted squarely to lathe bed, and tightened down with a nut and washer. The cross-slide was next moved outwards until the centre mark for the $\frac{3}{4}$ in. hole was in line with mandrel axis and the slide locked against further movement.

Much patient drilling ensued, working up by easy stages, and when the 1/20 h.p. motor gave up the ghost (after using 7/32 in. drill) the hole was opened up to $\frac{1}{2}$ in. diameter turning the mandrel by hand. A razor-sharp cutter mounted in a bar between centres eventually skimmed the hole to finished size.

The block was now removed and a small brass mandrel turned in chuck a tight fit in the $\frac{3}{4}$ in. hole, block mounted thereon, and the bore relieved about 1/64 in. deep for a distance of $\frac{1}{8}$ in. either side of centre-line. This obviated any possible tendency for the drilling-spindle to rock when gripped by its holder.

A hole was drilled and tapped where indicated to take the clamp-bolt, and the block neatly slotted using the "Eclipse" hand tool. The corners either side of the clamp-bolt were next sawn and filed as shown, to an angle of 45 deg., and the block finally bevelled and polished.

Before starting on the plate itself a little preliminary work was necessary; namely, the fitting of an extension-piece at rear end of mandrel.

A piece of $\frac{3}{8}$-in. mild-steel rod with a $\frac{1}{8}$ in. transverse hole drilled where shown was chucked truly, turned down to $\frac{5}{16}$ in. diameter for about $\frac{5}{8}$ in. length, and screwed $\frac{5}{16}$ in. B.S.F. for $\frac{1}{2}$ in. The mandrel was now reversed in headstock bearings, the hollow end tapped to match extension-piece, the mouth slightly counter-bored and the rod screwed very firmly home.

With its end supported by back centre, the remainder of rod was turned down to $\frac{5}{16}$ in. diameter, still further reduced at the extremity and screwed $\frac{1}{4}$ in. B.S.F. as shown. The mandrel was now returned to its normal position.

The writer was prepared to sacrifice the advantage of the hollow mandrel, at least temporarily, and regarded the extension-piece as a fixture. For readers who wish to retain this feature the rod could be made detachable by filing two flats close to the headstock end for a light spanner, but the fit of the threads should be especially neat.

Fig. 5 shows the method of mounting the new plate on the mandrel extension by means of a transverse steel pin engaging a closely fitting slotted collar of mild-steel. The plate fits neatly on to the $\frac{5}{8}$ in. diameter spigot of the collar and is clamped rigidly thereto by the brass hand-nut, the latter subsequently having shallow slots cut around its periphery (by the fly-cutter itself) to afford hand grip.

The master-plate had a larger centre hole than was desired in the smaller version and was, therefore, sandwiched between two large washers, adjusted to run truly, and secured by a $\frac{1}{4}$ in. B.S.F. nut, as shown in Fig. 3A, for "copying" purposes.

The detent (Fig. 5) is made from $\frac{1}{4}$-in. $\times$ $\frac{1}{16}$-in. mild-steel with a turned brass knob screwed and riveted at one end for disengaging from plate. A $\frac{1}{8}$-in. Whit. hole is tapped 2 in. from the top to receive the screwed point and a 5/32-in. hole drilled at the other end as indicated. The "set" shown on drawing is to impart a forward thrust when detent is engaging the plate in a vertical position.

The hardened coned point is a scrap of $\frac{1}{8}$-in. silver-steel, threaded, slotted for screwdriver, and provided with a lock-nut for adjusting purposes.

(To be continued)

QUERIES and REPLIES

"THE M.E." FREE ADVICE SERVICE. Queries from readers on matters connected with model engineering are replied to by post as promptly as possible. If considered of general interest the query and reply may also be published on this page. The following rules must, however, be complied with:

(1) Queries must be of a practical nature on subjects within the scope of this journal.
(2) Only queries which admit of a reasonably brief reply can be dealt with.
(3) Queries should not be sent under the same cover as any other communication.
(4) Queries involving the buying, selling, or valuation of models or equipment, or hypothetical queries such as examination questions, cannot be answered.
(5) A stamped addressed envelope must accompany each query.
(6) Envelopes must be marked "Query" and be addressed to THE MODEL ENGINEER, 19-20, Noel Street, London, W.1.

Self-acting Feed

My lathe has a leadscrew to operate the saddle feed, but no gearing for driving it automatically from the headstock. I do not wish to convert it to a screwcutting lathe, but would like to rig up a simple self-acting feed if possible. Is it practicable to drive the leadscrew by means of a belt, or in some other simple way, for this purpose?

M.B. (Dovercourt).

There are several simple methods of providing a self-acting feed on a non-screwcutting lathe, most of which have been described in the "M.E." at some time or other. One of the simplest is to fit a ratchet wheel on the leadscrew, and actuate it through a feed pawl from a cam or eccentric on the mandrel. The rate of feed can be varied by adjusting the throw of the pawl to gather one or more teeth. This produces an intermittent motion of the leadscrew, which may not always be desirable, but continuous feed could be produced by using double-acting pawls. Your suggestion to use a belt drive is practicable only if some further form of reduction gear is introduced in the drive. Direct belt drive from mandrel to leadscrew might possibly be arranged to give a reduction of 10 to 1, but this, in conjunction with an 8 t.p.i. leadscrew, would produce a feed of 0.0125 in. per turn of the mandrel, or 80 turns per inch, which is too coarse for most purposes. It is, however, practicable to use a simple worm gearing, driven by belt from the lathe mandrel or countershaft, and an article on such a device was published in the issues of the "M.E." dated July 15th and 29th, 1948. Some means of disengaging the drive when not required must be provided; in the case of a worm gear, the worm can be arranged so that it is capable of disengagement with the worm wheel, but in other cases it may be found necessary to introduce a dog clutch on the shaft or coupling which drives the leadscrew.

Lathe Tool Chatter

I find great difficulty in avoiding excessive chatter on my small lathe, although I have tried all possible variations of tool angle and setting. Please advise me how this may be remedied, or whether you consider it is due to an inherent fault in the design or construction of the lathe itself, which cannot be cured.

J.C. (Fareham).

Assuming the tools to be correctly ground, and set at the right height and cutting angle, the usual cause of chatter is inadequate support of the tool or the work, or both. This could be due to wear or bad fitting of the lathe bearings or slides, but as the lathe you are using is of a make which has been very popular among model engineers, it can hardly be ascribed to inherent faults in its design or construction. Refitting of the essential working parts may, however, be called for, and are not very difficult to carry out; numerous articles on this subject have appeared in the "M.E." Work should be securely mounted, and if projecting any great distance from the chuck, should be supported by the back centre wherever possible. Sometimes chatter is caused by a badly mounted tool, such as when the clamping surface is of inadequate area, or uneven packing (hacksaw blades, for instance) is used. On the other hand, chatter can sometimes be cured by using resilient packing, such as a slip of fibre, leather or hardwood, which has the property of damping out vibration. Even in the best small lathes, chatter will be caused by a tool having too much surface in contact with the work, such as with a broad parting tool, or a side tool taking a deep traversing cut. Jamming a tool into a corner, or taking a broad cut with too fine an in-feed will often set up a bad chatter. It is advisable, in all work on small lathes, to work with as narrow a cutting edge as practicable. But even the most experienced turner occasionally encounters a more or less persistent chatter, and there is no universal panacea for this annoying trouble.

Turning Slender Shafts

I have been trying to turn the inlet and exhaust valves for a model petrol engine from solid nickel steel, allowing an extra length to be held securely in the chuck, and turning the projecting part all over at one setting, then parting off. All goes well until I have turned down the stem almost to finished size, when excessive spring occurs, and it generally finishes up by the work riding up over the tool, and either bending or breaking off. How can I avoid this? I am almost in despair, having spoiled several valves.

P.G.A. (Flitwick).

Very slender work often produces problems which have to be dealt with in various ways according to their particular nature. Where it is not possible to use the back centre, some form of travelling steady can sometimes be rigged to follow or precede the tool point. The commercial method of producing work of this nature would probably be to use a "running-down" tool incorporating its own steady, such as a roller or a vee box tool. In this particular case we suggest that instead of trying to turn down the full length of the stem at once, you first turn down a short length, say, ¼ in., to finished size, and bevel the end slightly to an included angle of 60 deg. (This bevel is usually an advantage on the end of a valve stem rather than otherwise.) It is then possible to support the end in a hollow back centre, a temporary one being made or adapted if not otherwise available, and the rest of the turning on the stem can then be carried out with adequate support. Your suggested method of turning the essential surfaces of the valve, including the seating, all over at one setting, is sound, and can be recommended.

Renovating Water Mill

It is proposed to repair and put in order an old water mill of indeterminate but probably considerable age, on a local estate. The mill was once used for grinding corn, but it is proposed to adapt it to pump water. It has a wooden breast wheel, needing considerable repair and renewal of paddles, but structurally sound; the wooden hub has short axles driven in each end (now badly rusted), running in wooden half-bearings with grease lubrication, and has wooden crown and spur gearing with inserted teeth, which are also in bad condition.

Would it be worth while to take the trouble of fitting modern bearings to the wheel, and replacing the wooden gear teeth with metal ones, which could be cast to shape, using one of the old teeth as a pattern?

J.H.M. (Buxton).

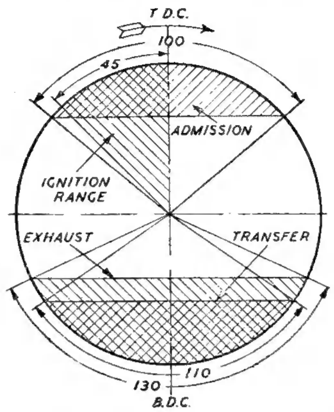
While it will be necessary to replace the wheel axles, or turn them down to produce an accurate surface, it is very doubtful whether there would be any substantial gain in efficiency by fitting what you describe as "modern" bearings, such as split plummer blocks or ball races. Water mills ran very well on their wooden half-bearings, and these lasted indefinitely at the low working speeds; under constant splashing with water, they were practically self-lubricating, and would probably give less trouble than a more elaborate form of bearing. Metal teeth could be used in the gearing, but would cause much more noise and vibration than wooden teeth; as a compromise, metal teeth in one wheel, meshing with another having wooden teeth, would probably work very well.

Two-stroke Engine Design

I am designing a two-stroke engine for industrial work, and find difficulty in arriving at the best arrangement, timing and dimensions of the ports. Examination of existing engines shows considerable divergence in all these respects, and I should be glad if you would inform me if there is any formula or other scientific basis on which essential factors can be calculated.

M.R. (Ruislip).

In dealing with engineering problems generally, it is often necessary to arrive at a compromise between incompatible factors, and this is particularly true in two-stroke engine design. Although it is possible to evolve formulae by studying the results of established tests with existing engines, these do not necessarily establish any "scientific" basis for design, and so far as we are aware, most new designs are evolved on the results of experience rather than calculation. Theoretically, the exhaust ports of an engine should open at the instant gas pressure drops to a level where it ceases to be of any real value in driving the piston. The transfer ports should open when the pressure has dropped still further, as a result of exhaust release, to balance exactly the pressure in the crankcase, and should remain open long enough to enable the mixture to be efficiently transferred to the cylinder, the exhaust ports then being closed before any substantial escape of mixture takes place. Inlet ports should be opened early enough to avoid unnecessary work being done in producing a vacuum in the crankcase; remain open long enough to take in the change, and close before it can be blown back again from the intake as the piston begins to descend. It is clear that these desiderata are not compatible with conditions obtainable with ports controlled by the piston, and even if obtainable, would only exist at one critical speed. It is found that the best port timing for speed and higher performance differs from that required for reasonable economy, pulling power at low speed, or maximum rate of acceleration; the designer must choose which of these properties is the most important in a particular case. A timing diagram which has proved satisfactory for general-purpose port-controlled engines is given herewith. This would serve as a basis for test and experiment, but no claim is made that it would give the best possible results in any particular engine.



Converting Aircraft Cine Camera

Please advise me what alterations are necessary to adapt an ex-service cine camera, as used for aircraft gunnery training, for normal use. The camera takes 16 mm. film in special daylight loading spools, and is driven by a 24 volt motor, which I should like to convert to work on a lower voltage if possible.

A.B. (Gloucester).

Cameras of the type described are usually fitted with lenses of fixed aperture and focus, sometimes with the addition of special long-range telephoto attachments. They could, of course, be used for long-distance or "infinity" work without alteration, but for general purposes, provision for adjusting both the focus and the aperture of the lens would be highly desirable. An entirely new lens mount, to take a focussing sleeve with a quick thread or helical slot, could be fitted; it would be necessary to calibrate the focus and provide a focussing scale on the mount. To adjust the aperture, the most common device is an iris diaphragm; but this may be found difficult or inconvenient to fit, and an alternative would be to slot the lens tube and use inserted stops with holes of different diameters, such as were once popular for photographic lenses. Regarding the conversion of the motor to run on lower voltages, this would necessitate rewinding, but we cannot give you definite advice on this matter without exact information on the motor design, including dimensions of field magnet, and number, shape and dimensions of armature slots. If you will furnish these particulars, and state the voltage you propose to use, we shall be glad to quote a fee for working out the new windings. You will, of course, realise that to run the motor at the same power and speed on reduced voltage, proportionately higher current consumption will be required.

Locomotive Boiler

I am building a 5-in. gauge 0-6-0 *locomotive, and propose to fit it with an all-brazed boiler. I would like your advice as to whether the back-head, front and back firebox plates and the front tubeplate could be butt-joined, instead of being flanged. I am experienced in brazing metals of different kinds and posses an air-gas blowlamp, or torch. Would a test pressure of* 300 *p.s.i. be enough?*

A.S.M. (Manchester).

We have had no experience of a boiler made in this way, but we see no reason why the form of construction you propose should not be satisfactory, provided all the brazing is thoroughly sound. However, we should feel more comfortable if the end plates were flanged. We suggest that, with your method of construction, you make absolutely certain that you leave a good fillet of spelter round the inside of every joint.

On no account apply so high a test pressure as 300 lb.; a pressure of 50 per cent. above normal working pressure is sufficient and should be applied for about 30 minutes. Also, be careful that the tubeplates are of thicker material than that of the barrel.